# REVIEW AND ANALYSIS OF ECONOMIC ACHIEVABILITY ASSESSMENTS OF ENVIRONMENTAL PROTECTION EXPENDITURES

DECEMBER 1990

Ontario
Environment
Environnement

91-02525/

ISBN 0-7729-7804-2

# REVIEW AND ANALYSIS OF ECONOMIC ACHIEVABILITY ASSESSMENTS OF ENVIRONMENTAL PROTECTION EXPENDITURES

Report prepared by:
KPMG Peat Marwick Stevenson & Kellogg
in association with Apogee Research International, Ltd.

Report prepared for:
Policy and Planning Branch
Ontario Ministry of the Environment

DECEMBER 1990

Cette publication technique
n'est disponible qu'en anglais

Copyright: Queen's Printer for Ontario, 1990
This publication may be reproduced for non-commercial purposes
with appropriate attribution

PIBS 1321

ACKNOWLEDGEMENT AND DISCLAIMER

This report was prepared for the Ontario Ministry of the Environment as part of a Ministry-funded project. The views and ideas expressed in this report are those of the author and do not necessarily reflect the views and policies of the Ministry of the Environment, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

(c) 1990 Her Majesty the Queen in Right of Ontario as represented by the Minister of the Environment

# Contents



Glossary.....(a)

Executive Summary.....(i)

I - Introduction.....1
Background.....1
Study Objectives.....2
Scope.....2
Structure Of This Report.....3

II - Approach.....5
The Economic Analysis Context.....5
A Two-Phased Approach.....8
Phase 1 – Evaluation And Critique Of Alternative EA Concepts.....8
Evolution Of The Study Approach.....10
Phase 2 – Making These Concepts Meaningful For Application In Ontario.....10
Reporting.....11

III - The U.S. Environmental Experience.....12
Origins And Application Of Economic Achievability In The U.S.....12
Definitions Of "Economically Achievable" And The Use Of Financial Analysis Techniques.....19
EPA Municipal Ability to Pay Models.....29
Information Needs.....30

IV - Distributional Considerations In Other Countries and Applications.....34
Canadian Environmental Experience.....34
Environmental Experience In OECD Countries.....42
Economic Achievability In Non-Environmental Programs.....49

V - Analysis of EA Concepts.....57
Introduction.....57
Definitions Of Economic Achievability.....57

# Contents



Financial Impacts ..... 60
Evaluation ..... 61
The Evaluation of the Basic EA Concepts ..... 62
Summary ..... 65

VI - Private Sector Financial Analysis Methodologies ..... 67
Introduction ..... 67
The Basic U.S. EPA Methodology ..... 67
The Private Sector Financial Analysis Methodologies in the Context of the Evaluation Criteria ..... 69

VII - Applicability To Ontario ..... 75
Introduction ..... 75
The Private Sector Perspective ..... 75
Municipal Sector ..... 83

VIII - Worked Examples ..... 88
Introduction ..... 88
Recap Of Study Findings ..... 88
Private-Sector Corporations ..... 90
Differences Between Data Sources ..... 90
Data Limitations ..... 91
Methodology And Assumptions ..... 91
Example 1 ..... 92
Example 2 ..... 95
Conclusions—Private Sector Examples ..... 97
Municipal Example ..... 98
Conclusions—Municipal Example ..... 100

**Appendices**

Appendix A - Case Studies

Appendix B - Financial Ratios as Predictors of Bankruptcy

Appendix C - Conservation and Protection Regulatory Initiatives (Canada)

Appendix D - Bibliography

# Contents



**Exhibits** **Overleaf**

Exhibit III-1—Major U.S. Environmental Statutes ..... 13

Exhibit III-2—Analytic Components of U.S. Economic Impact Analysis ..... 20

Exhibit III-3—Overview of Financial Ratios Used in U.S. EPA Industrial Sector Analyses ..... 21

Exhibit III-4—Measures of U.S. Municipal Financial Conditions ..... 28

Exhibit III-5 —Measures of U.S. Municipal Ability to Pay ..... 28

Exhibit III-6—Flowchart of Information Flow and Analysis: Organic Chemical Industry ..... 33

Exhibit VII-1—Criteria for Evaluating Municipal Debentures; Canadian Securities Course ..... 85

Exhibit VIII-1a—Dun & Bradstreet Worked Example ..... 93

Exhibit VIII-1b—Dun & Bradstreet Worked Examples; Pre-Compliance Financial Statements ..... 93

Exhibit VIII-1c—Dun & Bradstreet Worked Example; Post-Compliance Financial Statements ..... 94

Exhibit VIII-2a—CCH Worked Example; Income Statements ..... 95

Exhibit VIII-2b—CCH Worked Example; Balance Sheets ..... 95

Exhibit VIII-2c—CCH Worked Example; Ratio Tests ..... 96

Exhibit VIII-3—City of Sarnia; Financial Summary ..... 99

Exhibit VIII-4—Municipal Worked Example; Measures of Municipal Ability to Pay ..... 99

# Contents



Exhibit VIII-5—Municipal Worked Example; Allocation of Debt Service Charges to Sewer Enterprise.....99

Exhibit VIII-6—Municipal Worked Example; Measures of Municipal Financial Condition .....99

Exhibit A-1—Economic Impact Analyses Prepared Under the Clean Water Act ..... A-1

Exhibit A-2—Sample Derivation of Precompliance Financial Statements; Basis: Aluminum, 10 to 49 Employees ..... A-7

Exhibit A-3—Summary of 308 Survey Data for OCPSF Plants in Scope.....A-13

Exhibit A-4—Summary of EPA Effluent Guidelines and Standards.....A-24

Exhibit A-5—Definitions of Effluent Limitations, Guidelines and Standards—U.S. EPA.....A-24

Exhibit B-1—Comparison of Univariate Ratio Tests..... B-1

# Glossary

| | |
|---|---|
| BAT | Best Available Technology |
| BACT | Best Available Control Technology |
| BAT EA | Best Available Technology, Economically Achievable |
| Beaver's Ratio | Cash flow to total debt |
| BPT | Best Practicable Control Technology, Currently Available |
| CAA | Clean Air Act |
| CCA | Capital Cost Allowance |
| CWA | Clean Water Act (U.S.) |
| EA | Economically achievable, or economic achievability |
| EBIT | Earnings before interest and taxes |
| EC | European Communities |
| GATT | General Agreement on Tariffs and Trade |
| LAER | Lowest Achievable Emission Rate |
| MDA | Multiple Discriminant Analysis |
| MISA | Municipal-Industrial Strategy for Abatement |
| NAAQS | National Ambient Air Quality Standards |
| NSPS | New Source Performance Standards |
| OCPSF | Organic chemicals, plastics and synthetic fibres |
| OECD | Organisation for Economic Co-operation and Development |
| OMB | Office of Management and Budget (U.S.), or Ontario Municipal Board (Ontario) |
| OSHA | Occupational Safety and Health Administration (U.S.) |
| POTW | Publicly Owned Treatment Works |
| PSES | Pretreatment Standards for Existing Sources |
| PSNS | Pretreatment Standards for New Sources |
| RFA | Regulatory Flexibility Act (U.S.) |
| RIAS | Regulatory Impact Analysis Statements |
| ROA | Return on Assets |
| SBA | Small Business Administration |
| SIC | Standard Industrial Code |
| U.S. EPA | U.S. Environmental Protection Agency |
| U.S. SEC | U.S. Securities and Exchange Commission |
| WACC | Weighted average cost of capital |

# Executive Summary

## Introduction

### Background

The Ontario Ministry of the Environment has decided to put in place major initiatives aimed at virtually eliminating toxic contamination of the water, air, and land. The basic thrust of the air and water quality programs will be to set contaminant levels for effluents, and allowable emissions levels in air, using technology-based criteria. In the United States, where they were developed, some of the control methods are implemented with the proviso that they be "economically achievable" (EA). For example, the framework for setting contaminants levels in effluents is "Best Available Technology, Economically Achievable" (BATEA). In order to develop working definitions of various control concepts, and of the concept of "economically achievable," the Ministry is preparing position papers on these issues. With respect to the EA component, the Ministry needs a detailed understanding of the various definitions of the term "economically achievable" which have been used in other jurisdictions and in other circumstances.

### Objectives

The objectives of this study are to:

1. identify and critically review the origins and definitions of the term "economically achievable," and operational criteria used to implement the concept;

2. provide worked examples of operational and empirical criteria that can be used to judge what level or degree of environmental protection as "economically achievable;"

3. evaluate the criteria defined in objective 1 above.

The following section highlights the major findings of our study.

## The EA Concept in Perspective

The EA concept can best be understood in the context of applying economic benefit-cost analysis to the issue of setting abatement levels. Benefit-cost analysis can, in principle, help determine the appropriate level of abatement from an overall social perspective—i.e., one which represents the most efficient use of society's resources. However, it is also necessary to consider the distribution of the costs and benefits of environmental improvement. The EA concept, when applied to environmental pollution control technologies, addresses the distribution of costs and benefits, and related issues of equity.

## The U.S. Environmental Experience

One component of the study was the development of a background paper, exploring the origins and applications of the EA concept in the United States. In the U.S., the authority to consider the economic consequences of regulatory requirements is found primarily in statutes and executive orders. The study has reviewed the major environmental statutes in the United States, and the key phrases that guide the development of environmental standards. The term "economically achievable" appears only in the Clean Water Act, and is not defined. Other environmental statues make broader reference to economic considerations, but do not specify how they are to be measured. In addition, the requirements for the preparation of regulatory impact assessments and regulatory flexibility analyses provide some insight into the broad EA concept.

Practice in the United States makes it clear that the primary EA measures are the number of plant closings and job losses. In practice, for the private sector the EPA has used a number of financial indicators as predictors of plant closures and job losses. Generally speaking, the EPA considers analyses from the following perspectives:

- plant level analyses, which focus on the issue of plant viability and possible closure;

- firm level analyses, which focus on the financial health of the firm as a whole;
- national analyses which derive from the aggregation of plant level analyses.

The financial analysis tools used have varied over time, but typically include a combination of financial ratios and discounted cash flow analysis.

While there has been considerable exploration of the concept of ability to pay in the municipal sector, the EA concept per se has not been applied. This study has explored other attempts to assess municipal affordability or ability to pay for a number of environmental protection measures, and has identified a number of ratios and analysis techniques which have been used.

## Distributional Considerations in Other Countries and Applications

In addition to a detailed look at the U.S. EPA experience, the study has also explored distributional considerations in:

- environmental applications in Canada;
- environmental applications in OECD countries; and
- selected non-environmental applications in Canada and the U.S.

In Canada, the concept of economic achievability has generally not been formalized. In several jurisdictions, evaluation of environmental regulations includes a consideration of distributional effects; however, the approach to measuring them is not as well developed as in the U.S., nor is it consistently applied. Similar conclusions have been drawn with respect to the use of economic achievability considerations in OECD countries outside North America.

In the selected non-environmental policy areas studied, the conceptual framework used to address distributional considerations is similar to that which is typically used by the EPA. However, the concepts are not defined in statutes or regulations, and the analytical issues are not as well delineated as those in the environmental field.

## Analysis of the EA Concepts

The Terms of Reference and initial workplan for the study were based on the premise that a number of alternative EA definitions have been used in environmental and non-environmental applications. The results of Phase I of the study did not support this initial premise. For all practical purposes, there is only a single concept of "economically achievable" for the private sector, although it can be defined broadly or narrowly in different applications.

**The prevailing measure of economic achievability for the private sector is number of plant closings and jobs lost.** The greater the number of plant closings and jobs lost, the less "economically achievable" is a proposed regulation. We have identified the following additional variations with respect to this prevailing approach:

- Plant closures and job losses may be combined with additional indicators of economic achievability, which typically receive less weight and are analyzed in less detail.

- The definition of EA is often tailored to focus on small business.

The EA concept, as applied to categories or classes of municipalities in prospective analysis has not been widely used. However, there are approaches which have been used by the U.S. EPA by dealing with individual municipalities, within the broad EA framework.

In those jurisdictions where the approach has been sufficiently formalized to be considered established practice, the discussion and refinement of analysis has not been at the level of defining alternative EA concepts. The focus has been on methods used to implement the EA definition, which have typically been various financial analysis techniques.

The typical approach in the municipal sector is to use a number of financial indicators of the sort commonly used in municipal financial analysis to determine whether the financial strength of the municipality and/or the taxpayers can support the relevant expenditure.

The report evaluates the prevailing EA concept from a number of dimensions, including equity, applicability, comprehensiveness, incentives, and administrative requirements and cost.

## Private Sector Financial Analysis Methodologies

For the private sector, there is a clear distinction between the prevailing EA concept, based on various economic consequences, and the financial analysis methodologies which are used to implement the concept, i.e., to forecast job losses and plant closures.

The basic U.S. EPA methodology can be summarized as follows:

- The first step is the plant closure analysis, typically done using the discounted cash flow approach.
- The plant closure and profitability tests are usually supplemented by liquidity tests at the firm level.
- Compliance costs are related to firm and industry revenue, to determine the impact of total cost passthroughs, as well to determine the impact of the absorption of costs.
- Plant closures are aggregated across the industry to determine total employment and production capacity losses.

The financial analysis criteria have been analyzed in this study from the same perspectives as the EA concept itself. The key issue is as follows. There is broad recognition that the financial analyses should be undertaken at the plant level, and that the fundamental issue is the viability of individual production units, rather than corporate "deep pockets" per se. However, in order to make such an assessment, it is necessary to understand the production cost structure of individual plants. Except in unusual circumstances, such data are typically not available in either Canada or the United States. Much of the detail in a number of the U.S. EPA industry studies has been in response to this deficiency, i.e., an attempt to infer plant level cost data, typically by some form of analogy to firm level data available from other sources

## Applicability to Ontario

The basic EA concept used by the EPA, as applied to the private sector, appears to be broadly applicable in Ontario.

While the financial analysis tools used to forecast EA in the United States also appear to be broadly applicable in Ontario, there are a number of concerns which may limit their applicability to the Ontario situation. For example:

- There is not any identified "Made in Canada" empirical support for the forecasting methodology used in the U.S., although it appears to make sense on intuitive grounds.

- There do not appear to be studies which identify the appropriate thresholds which can be used as indicators in Ontario of severe economic harm at the individual plant or firm level.

- The industrial structure of the United States promotes the use of "model firm" or statistically-based analyses, which may be more difficult to apply in Ontario.

- The available information on the financial structure of firms in Canada, if used to proxy plant level economics for which data are not directly available, is likely to be less credible in Ontario than in the United States.

These concerns, and particularly the latter two are substantive, and place real constraints on the ability of the Ministry to directly transfer some of the detailed approaches used in the United States.

### Municipal Measures

The relatively strict provincial limits on the extent of municipal indebtedness may reduce the relevance of the types of municipal financial measures used in the United States to address the EA issue.

### Worked Examples

The study concludes with three worked examples, i.e., detailed quantitative illustrations of the application of certain aspects of the EPA approach, in the context of data likely to be available in Ontario. In addition, we provide some comments with respect to data availability and data requirements.

In short, "economically achievable" is not a well-defined term; rather, it is a concept that is still evolving. The term itself appears hardly at all in statutes and regulations, and where it does appear it is not clearly defined. Nevertheless, distributional considerations are becoming more important in the standard-setting process, as the regulatory burden placed on businesses and government agencies increases.

# I - Introduction

In this chapter, we summarize:

- the background to the study;
- the study objectives;
- factors affecting the scope of the study;
- the structure of this report.

## Background

The Ontario Ministry of the Environment has decided to put in place major initiatives aimed at virtually eliminating toxic contamination of the water, air and land. The main initiatives are:

- MISA, focused on reducing water pollutants and effluents from municipal sewage treatment plants and from industrial establishments;

- extensive revisions to Regulation 308 under the Ontario Environmental Protection Act, which deals with airborne contaminants and associated emission limits;

- Ontario waste management initiatives, focused on the diversion of significant proportions of the solid waste stream from landfilling and incineration to recycling and reuse, and on waste reduction activities.

The basic thrust of the air and water quality programs will be to set contaminant limits for effluents, and allowable emissions levels in air, using technology-based criteria. Depending on the type of pollution and the specific application, the technologies are described under various acronyms such as:

- Best Available Technology (BAT);
- Best Available Control Technology (BACT);
- Lowest Achievable Emission Rate (LAER);
- New Source Performance Standards (NSPS).

In the United States, where they were developed, some of these control methods are implemented with the proviso that they be "economically achiev-

able". In other words, the operative framework for setting contaminant levels in effluents is Best Available Technology, Economically Achievable (BATEA).

### Purpose of this Study

In order to develop working definitions of concepts such as BAT, LAER, NSPS, and "economically achievable," the Ministry is preparing position papers on these issues. With respect to the economically achievable component, the Ministry needs a detailed understanding of the various definitions of "economically achievable" which have been used in other jurisdictions and other circumstances. It also needs to assess and critique these definitions, both from a conceptual point of view, and in terms of their practical applicability.

In this report, the terms "economically achievable" and "economic achievability" are both used. For ease of reference, the letters EA are sometimes used to refer to both the adjectival and noun forms of the phrase.

## *Study Objectives*

The objectives of the study are stated as follows in the Terms of Reference:

1. Identify and critically review the origins and definitions of the term "economically achievable," and operational criteria used to implement the concept.

2. Provide worked examples of operational empirical criteria that can be used to judge what level or degree of environmental protection is economically achievable.

3. Evaluate the criteria defined in Objective 1 above.

## *Scope*

The scope of the work includes the following:

- The focus of the review is on the origins, definitions, applications and results of the term Best Available Technology, Economically Achievable (also known as Best Available Control Technology, Economically Achievable) as it has been applied in the U.S. to environmental public policy issues.

- The study should also consider:

  - the applications of the concept in environmental applications in jurisdictions outside the United States (and particularly any Canadian experience);

  - the applications of similar concepts in other areas of public policy outside those associated with air emissions, solid waste treatment disposal and waste water effluents, with a particular focus on the United States and Canada.

  In considering these other applications, it is recognized that there may be other terms in use with meanings similar to that of the EA concept—such as "affordable". These are also to be considered.

- The review must take into account and, where possible, distinguish among factors relevant for the application of the EA concept for the following types of entities making the expenditure:

  - private sector corporations;
  - municipalities;
  - crown corporations;
  - provincial and government agencies, and
  - other types of public or private agencies.

- The study should identify and comment on both ideal concepts and procedures and those which are practical and doable.

- The study is not intended to recommend a specific definition of the EA concept to be used by the Ministry. Instead, it is intended to present a range of data and analyses, conducted in an appropriately comprehensive and practical way, to permit the Ministry to develop its own views as to the most appropriate definitions of the concept.

## Structure Of This Report

The remainder of this report is structured as follows:

- In Chapter II, we discuss our basic approach to the study;

- Chapter III deals with the EA concept in U.S. environmental applications;

- Chapter IV discusses the EA concept and similar concepts, in a range of other jurisdictions and/or policy areas;
- Chapter V summarizes and analyzes the various EA concepts identified in the previous two chapters;
- Chapter VI focuses on the use of financial analysis tools to forecast changes in the indicators which are used to measure "economically achievable" in the private sector;
- Chapter VII discusses the applicability of the approaches used in other jurisdictions to the Ontario situation;
- Chapter VIII provides worked examples of selected financial analysis tools.

# II - Approach

In this chapter, we discuss our basic approach to the study. At the start of the project, the planned study approach was defined. As the research proceeded, it became clear that some of the original assumptions underlying the planned approach were inappropriate; the study approach thus evolved during the conduct of the work. The nature of this evolution is also described in this chapter.

We discuss the following issues:

- The economic analysis context of the work;
- A two-phased approach to the work;
- The nature of the Phase 1 analysis;
- The evolution of the study approach;
- The nature of the Phase 2 analysis;
- Reporting.

## The Economic Analysis Context

The role of the EA concept can best be understood by considering the economic issues that arise in selecting appropriate types and levels of emission control, as well as allocating the costs and benefits of such control. In the Request for Proposal, the Ministry outlined the three broad types of economic analysis and criteria relevant to setting such public policy objectives. These are:

- cost-effectiveness analysis
- benefit-cost analysis
- financial impact analysis.

These terms are not always used the same way in various applications. Thus, we discuss them in some detail below, in part to establish the conceptual framework within which we can discuss and critique various EA concepts.

### Cost-Effectiveness Analysis

**Cost-effectiveness analysis** is used to ensure that the least cost method for achieving a specific objective is employed. The results of such analysis are abatement cost functions; these can be thought of as graphs which, at any level of abatement, define the lowest cost for achieving this level. In other words,

each point on the curve corresponds to a set of specific abatement actions which, taken together, achieve the desired level of abatement at lower cost than any other set of feasible actions.

## Benefit-Cost Analysis

Abatement cost functions can tell us the lowest cost for achieving any level of abatement, but cannot in themselves determine the appropriate level of abatement from society's point of view. Benefit-cost analysis is a technique used in this second stage. Essentially, **benefit-cost analysis** identifies and values all public and private benefits and costs, including externalities. Given the nature of the abatement cost function and the "demand" for environmental benefits, the appropriate aggregate level of abatement is found at the point at which the incremental costs associated with pollution control are equal in value to the incremental benefits of achieving such control. Typically, lower levels of abatement than this "optimal" level are sub-optimal, in the sense that the value of additional abatement which can be accomplished exceeds the cost of doing so. On the other hand, "over-abatement" is a misuse of society's resources, since the value to society of the incremental benefits is exceeded by the incremental cost of achieving them.

## Financial Impact Analysis

The application of benefit-cost analysis can, in principle, help us determine the level of abatement which is appropriate from an overall social point of view – i.e., one which represents the most efficient use of society's resources. However, one of the criticisms of benefit-cost analysis as a technique (and not only in the environmental economics field) is that, in itself, it does not pay sufficient attention to who bears the costs and who receives the benefits. More generally, welfare economics, which is the branch of economics which concerns itself explicitly with the application of economics to policy issues, divides the question into two analytically separate parts:

- Is the program economically efficient?
- Are the income redistribution effects desirable?

Benefit-cost analysis, narrowly applied, tends to be restricted to questions of the first type. However, actual policy decisions often reflect considerable weight on answers to questions of the second type. In development economics, for example, benefit-cost analysis is often accompanied by extensive analyses of the distribution of the costs and benefits – e.g., which geographic regions, population segments, economic classes, and so on, bear which costs and receive which benefits.

For typical environmental improvements, the distribution of benefits is relatively widespread, while the distribution of costs may be quite narrowly

focused. For example, the benefits of reducing toxic chemicals in Lake Ontario may accrue to every resident of south-central and south-eastern Ontario. The cost of such a clean-up, however, may fall on the shareholders and employees of a small number of industries, as well as the communities within which they operate. The Ministry uses the term **financial impact analysis** to describe techniques which focus on the distribution of costs and benefits, with particular emphasis on assessing the extent to which individual firms, industries, communities, or, indeed the provincial government can afford to devote resources to specific environmental protection activities.

## The EA Concept

Experience has shown that considerations of impact, such as those described above, are often more important in political decision-making than the pure economic efficiency arguments which underlie the concepts of cost-effectiveness and benefit-cost analyses noted above. The concept of "**economically achievable**," when applied to environmental pollution control technologies, addresses such considerations.

The concept ultimately relates to the equity of the application of schemes, in terms of the distribution of the burden of costs over the various sectors and individuals in society. It is often concerned with the magnitude of costs in relation to the ability to pay. Each of the following groups has a different perspective on the issue of equity:

- taxpayers;
- shareholders and management of affected firms;
- employees of affected firms;
- customers of affected firms;
- suppliers to affected firms.

The term "economically achievable" implies that there are criteria or tests which can be used to determine just how much money and effort can be imposed on different sectors of society. In fact, in comparison with the other levels of economic analysis outlined above, the EA concept is not well established. Its application has often been very specific to the circumstances of particular projects under consideration. A range of ad hoc tests and "rules of thumb" have been used, but there does not appear to be the consistency or the academic agreement which underlies other stages of the process.

In short, "economically achievable" is not a well-defined term; rather, it is a concept that is still evolving. The term itself appears hardly at all in statutes and regulations, and where it does appear it is not clearly defined. Nevertheless, distributional considerations are becoming more important in the standard-setting process, as the regulatory burden placed on businesses and government agencies increases.

The concept of "economically achievable" has received the most explicit attention in the United States, where it is used by the U.S. Environmental Protection Agency in some of its rulemaking processes. It is for that reason that the study focuses on U.S. applications of the concept. However, we also consider other applications of financial impact analysis, which may deal with concepts like "affordable", "without excessive costs", or "analysis of distributional effects".

## A Two-Phased Approach

With this background, we now discuss the study approach, which was structured in two phases.

The first phase was intended to:

- identify a wide range of alternative EA definitions;
- critically evaluate these definitions;
- prepare an interim report which, in addition to identifying any required changes to the remaining work plan, was intended to narrow the range of EA definitions to those of sufficient interest to merit further analysis in Phase 2.

In Phase 2, for each of the selected EA definitions, the study was to:

- identify and assess information requirements, and
- develop worked examples.

We describe the approach and its evolution in more detail below.

## Phase 1 – Evaluation And Critique Of Alternative EA Concepts

The first phase of the work was an identification and critical evaluation of various definitions of "economically achievable", as they are used in a number of applications. It had three steps, as outlined below.

### Analytical Framework

The first substantive step was the establishment of an analytical framework, encompassing the following dimensions;

- detailed definitions of evaluation criteria and their application;
- the implications, for both the definition of evaluation criteria and their application, of the range of types of entities undertaking the expenditure;
- the implications of assessing "economically achievable" from both the public and private perspectives;
- the implications of seeking to assess and evaluate definitions in a way that adequately deals with, yet recognizes the differences between, ideal concepts and procedures and those which are practical and doable.

The framework, and its application, are described in more detail in Chapter V.

### Background Paper

The second step was the preparation of a background paper on the origins and evolutions of the EA concept. This background paper has been incorporated into Chapter III and Chapter IV of this report. The basic approach to its production was as follows:

- The legislative history of major federal U.S. statutes was examined for the explicit use of the terms "economic achievability."
- Next, several studies conducted by EPA's program offices were examined to reveal the methodology used in each case for determining economic achievability. These examinations are referred to as case studies. In Chapter VIII, the methodologies uncovered in the case studies are illustrated using Canadian data. These illustrations are referred to as worked examples.
- The Canadian federal government and the provinces of Ontario, British Columbia, Alberta, and Quebec were contacted to determine whether EA or related concepts had been defined or used in setting environmental regulations.
- A limited literature review was undertaken to determine if EA or related concepts had been defined or used in the environmental area in other OECD countries.
- A number of non-environmental policy areas were examined, both in Canada and the United States, to determine if the EA concept had been defined and used in those areas. As part of

this component, academics and research institutions were contacted in both Canada and the United States to seek to identify alternative EA definitions and other useful information.

### Evaluation And Analysis

The final Phase 1 task was a critical evaluation of the various definitions of "economically achievable" developed in Chapters III & IV. Thus, in this task we:

- identified specific operational definitions of "economically achievable", based on Chapters III and IV;
- assessed them against the evaluation criteria.

## *Evolution Of The Study Approach*

The study findings at this point led to a shift in the focus of the project. Contrary to the expectations underlying the original study approach, Phase 1 led to the identification of only a limited number of alternative EA concepts. In addition, the results to this stage made it clear that, when applying the EA concept to the private sector, the bulk of the relevant discussion and analysis which has taken place has focused, not on alternative EA concepts, but on specific methods of forecasting plant closures and employment losses, primarily through the use of various financial analysis techniques.

Consequently, at this stage it was decided that, for the private sector, the most appropriate approach to the remainder of the study was to focus on alternative financial analysis techniques used to forecast plant closures and job losses, rather than on alternative EA concepts per se.

For the municipal sector, there has not been as much attention placed on the EA concept. However, analogous concepts were identified in which EA itself was essentially defined in terms of financial analysis.

No clearly defined EA concepts were identified for the other entities to be dealt with, i.e., Crown corporations, and various forms of public and private agencies.

## *Phase 2 -- Making These Concepts Meaningful For Application In Ontario*

As originally conceived, Phase 2 had two basic steps. For the "short list" of EA concepts brought forward from Phase 1, these steps were to:

- identify and assess information requirements to support their implementation;

- develop worked examples of their application to each of the various entities under study.

As the study approach evolved, these two tasks remained essentially intact, but with a shift in focus along two dimensions:

- a shift to a broader assessment of the implications of Phase 1 findings for the use of the EA concept in Ontario, and in particular the transferability of approaches developed elsewhere;

- for the private sector EA concept, a focus on alternative financial analysis techniques used to forecast the key EA measures (plant closures and job losses), rather than on alternative EA concepts per se.

## Reporting

The reporting structure of the assignment was designed to reflect the research nature of the project. At the end of each step, a working paper was prepared and reviewed with the Ministry Steering Group. These working papers, appropriately restructured and edited, have formed the basis of much of this final report.

# III - The U.S. Environmental Experience

This chapter examines the use of the EA concept to set "best available technology" (BAT) standards in the environmental field in the United States. The purpose of this chapter is to identify alternative measures of economic achievability and describe how those measures have been used in the standard-setting process.

The chapter provides the following information:

- A review of the EA concept in statutes and regulations in the United States, and a description of how economic achievability has been used in the standard-setting process;
- A list of financial measures for both the private and the public sector that have been used alone or in combination to define and assess economic achievability;
- A description of the types of information needed to assess economic achievability and the means by which that information is obtained in the United States.

Case studies—examples of the use of EA in setting effluent guidelines for two sectors, and in developing land disposal restrictions for hazardous waste disposal in the United States—are provided in Appendix A.

## Origins And Application Of Economic Achievability In The U.S.

This section examines the references which are made to economic achievability and other economic considerations in the major regulations which describe or affect environmental programs in the U.S.

The authority to consider the economic consequences of regulatory requirements is found primarily in statutes and executive orders. Many of these apply to the U.S. Environmental Protection Agency (EPA), which is authorized to issue regulations under several different acts of Congress. The major statutes are:

- the Clean Water Act;
- the Clean Air Act;
- the Safe Drinking Water Act;
- the Toxic Substances Control Act;
- the Resource Conservation and Recovery Act;
- the Comprehensive Environmental Response, Compensation and Liability Act;
- the Federal Insecticide, Fungicide, and Rodenticide Act.

Exhibit III-1 lists the major environmental statutes in the United States and the key phrases that guide the development of environmental standards. As noted, the term "economically achievable" appears only in the Clean Water Act. In addition to these statutes, Executive Order 12291 requires all federal agencies to conduct Regulatory Impact Analyses of the costs and benefits of major proposed regulations. Finally, the Regulatory Flexibility Act requires consideration of the effect of regulations on small entities.

Some of the laws under which EPA is authorized to issue regulations permit relatively broad flexibility when considering economic factors in the decision-making process. With other laws, however, the scope of EPA's discretion is more narrowly defined by the enabling legislation. The following paragraphs summarize EPA's legislative authorities and discuss the extent to which EPA is able to consider economic consequences in making rules under each act.

## Clean Water Act

Under the Clean Water Act (CWA), EPA's principal rule-making activity is to establish effluent limitation guidelines for industrial and municipal wastewater treatment facilities. The statutory language concerning the 1983 amendments include explicit language directing the consideration of economic achievability. Section 301(b)(2)(A) states that "effluent limitations for categories and classes of point sources" are to be achieved which will require "application of the best available technology economically achievable for such category or class." The statute further specifies that such determinations are to be made based on the characteristics of the "category or class" of dischargers rather than the characteristics of individual point sources.

Normally, firms in the same category would be regulated on a sectoral basis. Furthermore, section 301(c) provides that the 1983 limitations may be modified (or eased) if the owner of a plant shows that "such requirements (1) will represent the maximum use of technology within the economic capability of the owner or operator; and (2) will result in reasonable further progress toward the elimination of discharge of pollutants." This provision shows that the section 301(b) limitations for 1983 are to be established prior to consideration of the characteristics of the individual plant. Moreover, it shows that the term

EXHIBIT III-1

MAJOR U.S. ENVIRONMENTAL STATUTES

| Statute | Key Phrase | Reference |
|---|---|---|
| Clean Water Act | economically achievable | Section 301(b)(2)(A) |
| Clean Air Act | technology forcing | Section 202(a)(2) |
| Safe Drinking Water Act | no known or anticipated effects on the health of persons | Section 101(b)(4) |
| Toxic Substances Control Act | unreasonable risk of injury to health or the environment | Section 6(a) |
| Resource Conservation and Recovery Act | protect human health and the environment | Section 3002(a) |
| Comprehensive Environmental Response, Compensation and Liability Act | substantial danger to the public health | Section 102(a) |
| Federal Insecticide, Fungicide, and Rodenticide Act | unreasonable adverse effects on the environment | Section 3(c)(5)(C) |

Source: Compiled by Apogee Research, Inc., Bethesda, MD, December 18, 1989

"best available technology economically achievable" does not refer to each individual plant, but to a class of similar plants.

In the absence of effluent limitation guidelines and standards for a category or class of dischargers, however, dischargers are still subject to limitations on their effluents. These limits are established by permit writers on a plant-by-plant basis, using "best professional judgement". The permit limitations must reflect both engineering and economic considerations.

The U.S. EPA has provided permit writers with workbooks that outline criteria for evaluating the affordability of effluent limitations for individual plants [1] Many of the financial measures contained therein are similar to ones used by the EPA to assess the "economic achievability" of effluent limitation guidelines for categories and classes of dischargers. For this report, we have focused on these latter measures of "economic achievability", which relate to industries or groups of industries. We have not explored the use of the EA concept in the issuance of individual permits, based on criteria other than the EPA's effluent guidelines.

## Clean Air Act

The Clean Air Act (CAA) requires EPA to issue many different types of regulations for different types of emission sources. Depending on the source and the pollutant, the Act places different requirements on the rule-making process. For some regulations, such as the National Ambient Air Quality Standards (NAAQS), the statute explicitly speaks only of effects of the regulation upon public health. For others, such as most emission standards for motor vehicles and aircraft, the CAA calls for analysis of the cost of compliance. For regulations that control or prohibit types of motor vehicle fuels, the CAA specifically requires a benefit-cost analysis in some circumstances.

The consideration of economics in implementing the CAA and proposing new regulations has evolved through judicial interpretation. The 1970 Amendments to the CAA place the primary responsibility for formulating pollution control strategies on the States, but nonetheless subject the States to strict minimum compliance requirements.

No reference to "economic achievability" is found in the Clean Air Act, but where Congress intended the EPA Administrator to be concerned about economic and technological feasibility, it expressly so provided. For example, Section 111 of the Act directs the Administrator to consider economic and tech-

---

1 See, for example, "Guidance Manual and Workbook for Estimating the Economic Effects of Pollution Control Costs," Office of Analysis and Evaluation, U.S. Environmental Protection Agency, November 1983; "Protocol for Determining Economic Achievability for NPDES Permits," Putnam, Hayes and Bartlett, Inc., August 12, 1982.

nological feasibility in establishing performance standards for new stationary sources of air pollution based on the best available control technology. In contrast, Section 109(b) speaks only of protecting the public health and welfare. Nothing in Section 109(b) suggests that the Administrator is to consider economic or technological feasibility in setting ambient air quality standards.

The legislative history of the Act also shows that the Administrator may not consider economic and technological feasibility in setting air quality standards. The absence of any provision requiring consideration of these factors was a deliberate decision by Congress to subordinate such concerns to the achievement of health goals.

Section 109 together with Sections 108 and 110 are of a "technology forcing character" and are expressly designed to force regulated sources to develop pollution control devices that might at the time appear to be economically or technologically infeasible.

### The Safe Drinking Water Act

Under the Safe Drinking Water Act, EPA must establish primary drinking water regulations for each contaminant which "may have an adverse effect on the health of persons..." The primary drinking water regulations for each contaminant are to based on a maximum contamination level goal (MCLG), set "at a level at which . . . no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety." The MCLG is based upon health effects. The primary drinking water regulations are to specify a maximum contaminant level (MCL), set as close to MCLG as is feasible. The term "feasible" is defined in the Act as meaning "feasible with the use of the best technology, treatment techniques, and other means, which . . . are available." No reference is made to EA.

### The Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) authorizes EPA to prohibit, restrict or regulate the manufacture, processing, distribution in commerce, use or disposal of any substance that presents "an unreasonable risk or injury to health or the environment." The language of TSCA calls for consideration of health and environmental effects as well as economic consequences, but does not define "economic consequences." The statute does not refer to EA in setting regulations.

## The Resource Conservation And Recovery Act

The Resource Conservation and Recovery Act (RCRA) directs EPA to promulgate regulations for generators and transporters of solid waste, as well as owners and operators of solid waste treatment, storage, and disposal facilities. RCRA places the emphasis in rule-making upon establishing standards to protect human health and the environment. The Act does not mention costs or economic considerations.

## Comprehensive Environmental Response, Compensation and Liability Act

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Re-authorization Act of 1986 (SARA), governs EPA's cleanup of inactive hazardous waste disposal sites. EPA must designate which substances are to be considered hazardous and must set the minimum quantities for reporting releases. These are to based upon whether such releases "may present substantial danger to the public health or welfare or the environment." In establishing reportable quantities, therefore, EPA may consider most benefits, but the Act is silent with regard to cost, economic impact analysis, and economic achievability.

## Federal Insecticide, Fungicide and Rodenticide Act

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) is primarily a licensing statute. Most of EPA's actions under FIFRA have to do with registering, and then modifying or cancelling the registration of pesticides. The use of economic factors in the permitting process is not specified in the Act.

## Regulatory Impact Analysis

President Reagan's Executive Order 12291 of 1981 replaced the Regulatory Analysis with the Regulatory Impact Analysis (RIA). The RIA not only restored the consideration of benefits to the regulatory process, but also subtly changed the emphasis of regulatory development. Executive Order 12291 requires regulatory objectives to be chosen that maximize the net benefits to society. The RIA also considers the distributional impacts of alternative regulatory approaches (that is, who pays and who benefits under different regulatory strategies).

Under Executive Order 12291 each agency is required to prepare and, to the extent permitted by law, consider an RIA for every major rule. A major rule is

defined as any regulation that is likely to result in (1) an annual effect on the economy of $100 million or more; (2) a major increase in costs or prices; or (3) significant adverse effects on competition, employment, investment, productivity, innovation, or the international competitive position of U.S. firms.

As specified in Executive Order 12291, the contents of each RIA must include:

1. A description of the potential benefits of the rule, including any beneficial effects that cannot be quantified in monetary terms, and the identification of those likely to receive the benefits;

2. A description of the potential costs of the rule, including any adverse effects that cannot be quantified in monetary terms, and the identification of those likely to receive the benefits;

3. A determination of the potential net benefits of the rule, including an evaluation of effects that cannot be quantified in monetary terms;

4. A description of alternative approaches that could substantially achieve the same regulatory goal at lower cost, together with an analysis of the potential benefits and costs and a brief explanation of the legal reasons why such alternatives, if proposed, could not be adopted; and

5. Unless covered by the description required under paragraph (4) of this subsection, an explanation of any legal reasons why the rule cannot be based on the requirements set forth in Section 2 of this Order.

Executive Order 12291 recognizes that many environmental statutes have established other criteria for setting regulations, and qualifies its directive to maximize net benefits with the phrase "to the extent permitted by law." Within this constraint it essentially lays out a requirement for a benefit-cost analysis which takes into account distributional considerations, as outlined above.

## Regulatory Flexibility Analysis

The Regulatory Flexibility Act (5 USC 601 et. seq.) requires agencies to assess the effect of regulations on small entities and to examine regulatory alternatives that may bring about any adverse economic effects on this group. The Act requires agencies to prepare an initial Regulatory Flexibility Analysis (RFA) to accompany any notice of proposed rulemaking. A final RFA that incorporates public comment must accompany a final rule. The purpose of the RFA is to evaluate the impact of proposed rules on small entities. The Act specifies that the RFA must identify the categories of small entities affected by the regulation

and analyze alternatives that could reduce the economic burden while still accomplishing the goals of the rule.

EPA sets guidelines and criteria for determining when a rule will impose a significant impact on a substantial number of small entities[1]. The guidelines address procedures for:

- identifying the small entities affected by the rule;
- determining if a substantial number of small entities are affected by the rule;
- evaluating if the rule has significant impacts on these small entities.

The Act specifies that the term "small entity" includes small businesses, small organizations, and small government jurisdictions. The Regulatory Flexibility Act defines small businesses as those firms that satisfy the criteria established under Section 3 of the Small Business Act (SBA). This part of the SBA states that the definition of small business can vary by industry sector to allow for special factors, but that three aspects of a firms operations should be considered:

- number of employees;
- dollar volume of business; and
- ownership and degree of dominance in its field of operation.

The Agency may use an alternative definition of "small business" after consultation with the Small Business Administration (SBA) and public comment. Similarly, alternative definitions of small organizations and small government jurisdictions are allowed after public comment.

The Regulatory Flexibility Act specifies that an RFA is required only if a substantial number of small entities are likely to incur adverse economic impacts. The Act does not specify, however, the criteria for determining if a "substantial number" of small entities are affected. EPA states in its guidelines that if at least 20% of the universe of small entities are affected by the proposed rule, then an RFA is required.

The EPA guidelines suggest that four criteria be applied to evaluate if a regulation will have a significant impact on a substantial number of small entities. If any one of the four criteria are satisfied, the regulation is assumed to have a significant impact. The four criteria are as follows:

---

1 Memorandum from the EPA Administrator, "EPA Implementation of the Regulatory Flexibility Act," (February, 1982).

1. Annual compliance costs increase the relevant production costs for small entities by more than 5%;

2. The ratio of compliance costs to sales will be 10% higher for small entities than for large entities;

3. Capital costs of compliance represent a significant portion of the capital available to small entities, taking into account internal cash flow plus external financing capabilities; and

4. The costs of the regulation will likely result in closure of small entities.

The RFA should compare costs of compliance for small and large entities to determine if the small entities are affected disproportionately. It should also analyze the ability of small entities to pass on these costs in the form of price increases and the effect on profitability. It should also predict the resulting effects (if any) on closures, production, and employment in each segment.

## Definitions Of "Economically Achievable" And The Use Of Financial Analysis Techniques

As the preceding review of statutory authority in the United States demonstrates, the term "economically achievable" appears only once in statute, and where it does appear (i.e., Section 301(b) of the Clean Water Act), it is not defined. Other environmental statutes make broader reference to economic considerations, but do not specify how they are to be measured. In addition, the requirements for RIA's and RFA's provide some insight into the broad concept. However, there is no explicit definition of economic achievability per se.

The Congressional debate on reauthorization of the Clean Water Act provides one of the few indications of what Congress meant when it introduced the term "economically achievable "– that is, consideration of plant closures and job loss[1]. The EPA's Office of General Counsel believes that, based on the Congressional record and the language of the Act, these are the only measures that can be used to determine economic achievability. Accordingly, the EPA has used the number of plant closings and jobs lost as measures of economic achievability in its rule-making process under the Clean Water Act.

In practice, EPA has used a number of financial measures as predictors of plant closures and job loss, and, therefore, of economic achievability. Listed below are a number of financial measures that have been used alone or in com-

1 Congressional Record. Weyerhaeuser Co. v. Costle, 590 F. 2d 1011 (D.C., Cir. 1978).

bination to assess economic achievability. Such measures differ for the private and public sectors, and are presented separately here.

### Private Sector

The economic impacts of proposed regulations are often measured by calculating the effect of additional compliance costs on both the financial statements of affected firms and/or the cost structures of individual plants, and inferring the number of closures by the extent of the impact. As shown in Exhibit III-2, the key analytical building blocks for the analysis are the plant, firm, and national level analysis. These analyses differ in both the entities being examined and the kinds of questions being asked. Generally speaking, the analyses are performed from the following perspectives:

- The plant level analysis is the central component of the economic impact assessment. Compliance costs are incurred at the plant level. These costs, together with baseline conditions, are used to conduct the plant closure analysis. The plant level analysis is performed from the perspective of corporate management to determine whether to keep the plant in operation.

- The firm level analysis is performed from the perspective of stockholders and lending institutions who will be sources of new equity or debt capital. The firm level analysis looks at the firm's overall financial viability, given increased compliance costs.

- The national analysis derives from the plant level analysis and examines the aggregate impact on society of the regulations. It is, essentially, a compilation at the national level of the plant-level closures, and associated losses in productive capacity and jobs.

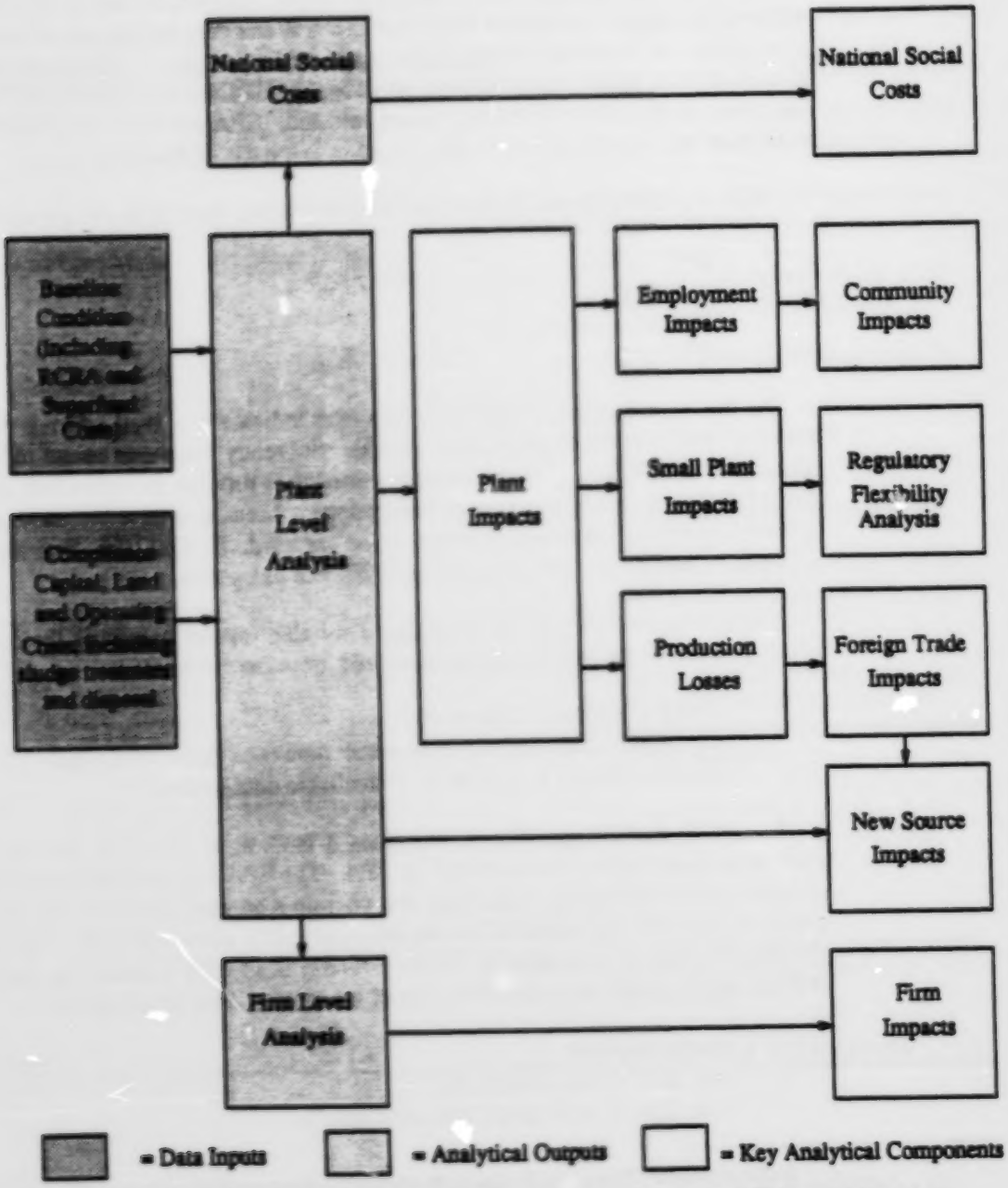
The outputs of such analyses are estimates of the measures of economic consequences of specific regulations. EPA typically uses financial ratios and cash flow analyses to estimate the economic impacts at the plant, firm, or national level for different levels of abatement that are technologically achievable. These and other, non-financial, measures are described below.

#### Financial Ratios

In the United States, the use of financial ratios to predict financial distress has received considerable examination in the academic literature and within EPA. In these studies, several types of ratios have recurred consistently as being reasonable predictors of firm failure. A number of studies have used different statistical methodologies and ratios. All of them demonstrated that the

## Exhibit III-2

### Analytic Components of Economic Impact Analysis




Source: U.S. Environmental Protection Agency, Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Organic Chemicals, Plastics and Synthetic Fibers Industry September 1987.

financial ratios of bankrupt and non-bankrupt firms are consistently different, and that these differences are evident before failure. As such, financial ratios can be used as indicators of potential bankruptcy.[1]

EPA, in the preparation of its economic impact analysis for one of the early effluent limitations guidelines under the Clean Water Act, conducted an extensive review of financial ratios as predictors of bankruptcy.[2] EPA's concern stemmed from public comments on proposed regulations that questioned both the ratios used and the threshold values selected. EPA set out to examine the theoretical and empirical justification inherent in the use of financial ratios.

EPA found that financial ratios can be grouped into four basic categories:

- profitability;
- solvency;
- liquidity; and
- efficiency.

As the name implies, profitability measures indicate how well a firm is performing with respect to generating profits. Solvency measures relate to the amount of debt a firm carries. Liquidity measures provide an indication of a firm's ability to meet short-term obligations. Measures of efficiency are intended to reflect the extent to which assets are used. Exhibit III-3, lists some of the most commonly used ratios in each of these categories.

EPA, in its analysis, determined that a suitable test for assessing the economic impacts of proposed regulations should meet three criteria:

- strong empirical justification;
- threshold values derived from recent data (i.e., since 1978); and
- simple, consistent application to available data sources.

Exhibit B-1, in Appendix B, provides a review of seven of the most promising single ratio tests examined by EPA. The EPA also examined a range of multivariate tests (single equations that contain a number of ratios), but was unable to find one for which all of the necessary data were available. This is discussed further in Appendix B. In the Foundry Study, EPA found that three of these seven single ratios satisfied most of the three criteria listed above:

- return on assets;
- total debt to total assets; and
- cash flow to total debt ("Beaver's ratio").

---

1 William Beaver, "Financial Ratios as Predictors of Business Failure," Empirical Research in Accounting: Selected Studies, 1966.

2 "Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Metal Molding and Casting (Foundry) Industry," U.S. EPA, September 1985. (Referred to in this report as the "Foundry Study.")

EXHIBIT III-3

## OVERVIEW OF FINANCIAL RATIOS USED IN U.S. EPA INDUSTRIAL SECTOR ANALYSES

| Category | Financial Ratio | Description |
|---|---|---|
| Profitability | ROA | Return on assets (net income after taxes divided by total assets) |
| | EBIT/TA | Earnings before interest and taxes divided by total assets |
| | EBIAT/TA | Earnings before interest but after taxes divided by total assets |
| | ROS | Return on sales (profit divided by sales) |
| Solvency | CF/TD | Cash flow (net income plus depreciation) divided by total debt |
| | TD/TA | Total debt divided by total assets |
| | EBIT/TI | Interest coverage (earnings before interest and taxes divided by total interest charges) |
| Liquidity | CA/CL | Current ratio (current assets – cash, marketable securities, accounts receivable, inventories – divided by current liabilities) |
| | QA/CL | Quick ratio (quick assets – cash, marketable securities, accounts receivable – divided by current liabilities) |
| | NWC/TA | Net working capital (current assets minus current liabilities) divided by total assets |
| Efficiency | S/TA | Sales divided by total assets |

Source: "Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Metal Molding and Casting (Foundry) Industry," U.S. EPA, September 1985.

Applying these ratios as tests required some assumptions about the internal consistency of different ratios (for example, ensuring consistent treatment of balance sheet items across ratios). However, fewer assumptions are required for these tests than for the other measures listed in Exhibit B-1. In addition, and the single most important factor in EPA's selection, was the strong empirical base for these ratios – that is, the ratios provided a clear delineation between bankrupt and non-bankrupt firms in the sample population used in the research. Appendix A includes a discussion of EPA's derivation of threshold values for these ratios for the foundry industry.

In part, the Foundry Study appears to have used firm-level financial ratios to predict plant closure because of the large number of plants, and the resulting difficulty in gathering industry-wide plant-specific data. While the Foundry Study is one of the most detailed and involved studies by the EPA, it is the only one that we know of that uses the three financial ratios noted above to predict plant closure.

In the Organic Chemicals Study, the EPA used financial ratios to assess the effect that compliance with regulations would have on the liquidity or profitability of the firm[1]. These firm-level ratio tests were designed to complement the plant closure analysis, which was done using the cash flow approach.

The EPA's rationale for using firm-level financial ratios in addition to plant closure analysis is as follows. The EPA reasoned that it is the firm, rather than the plant, which has to raise the capital required for abatement equipment. External lenders and investors would evaluate the firm's, rather than the plant's, financial attractiveness. Although a cash flow analysis might indicate that a plant should remain open, a weak parent firm might be unable to raise the necessary funds. The EPA argued, however, that such a plant would probably be sold as an operating facility, rather than being forced to close and that, therefore, this analysis would not add to the predicted number of plant closures.

The firm-level analysis by the EPA is not inconsistent with the assertion that profitability must be evaluated at the plant-level to predict closure. The firm-level analysis was intended to identify those special situations where the compliance of a financially healthy plant with effluent guidelines could be delayed because the plant was owned by a financially weak firm. A weak firm is unlikely to have internal funds to invest, even in a profitable plant. External investors will examine the firm, rather than the plant, since the firm is the legal entity in which they invest.

---

1 "Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Organic Chemicals, Plastics and Synthetic Fibers Industry", U.S. EPA, September, 1987. (Referred to in this report as the "Organic Chemicals Study.")

This is quite different from the situation where an unprofitable plant is owned by a financially strong firm. A plant within a multi-plant firm must typically compete internally with the firm's other plants and businesses for access to the firm's investment capital. A financially strong firm may decide to close an unprofitable plant if it can obtain a higher return on its funds elsewhere. The constraint is not the firm's **inability** to raise the funds necessary for compliance (either through retained earnings or from external financial markets), but the firm's **unwillingness** to invest the funds. The company's internal market for funds is therefore the limiting factor.

In the Organic Chemicals Study, the firm-level financial analysis considered two factors. The first factor was the ability of the firm to meet its fixed cost obligations. If, as a result of compliance, the firm fell below the lowest quartile in terms of both its interest coverage and current ratio, relative to industry norms, the EPA judged it to be financially vulnerable. The second factor was a combined measure of profitability and stability. The EPA considered a firm to be financially vulnerable if its ratio of debt to assets exceeded the industry's upper quartile value, and if its return on assets was below the lowest quartile.

### Cash Flow Analysis

The approach used more frequently by the EPA to estimate plant closures is a widely accepted corporate finance technique – a discounted cash flow analysis[1]. In a discounted cash flow analysis, the stream of future earnings from a project or a firm are calculated and then discounted (present value) using the firm's or industry's average rate of return.

EPA used this approach in the Organic Chemicals Study and in its analysis of the non-ferrous metals manufacturing industry[2]. In those analyses, a plant was projected to close if the present value of the plant's future cash flow minus the cost of compliance expenditures was less than the plant's current salvage value. In other words, if the plant was not generating revenues greater than the estimated salvage value after meeting the new regulatory requirements, EPA assumed that management would choose to close the plant. The present value of the future cash flow is calculated by discounting the expected income stream by the weighted average cost of capital (WACC). In order to account for the higher perceived risk of small firms and the more limited sources of funds available to them, the WACC was assumed to vary with firm size.

---

1 Personal communication with Mark Lutner, U.S. EPA.

2 "Economic Impact Analysis of Effluent Limitations and Standards for the Non-ferrous Metals Manufacturing Industry, Phase I," U.S. Environmental Protection Agency, February 1984. (Referred to in this report as the "Non-ferrous Metals Manufacturing Study.")

In the Organic Chemicals Study, large firms, with sales over $131 million U.S. were assumed to have a WACC of 8.11% . Medium size firms, with sales between $17.5 and $131 million were assumed to have a WACC of 9.55%, while small firms with sales up to $17.5 million were assumed to have a WACC of 10.51%.

EPA's plant closure decision rule can be stated as follows:

Close if salvage value > PV cash flow, defined as present value of (cash flow - treatment costs).

The cash flow approach is theoretically attractive, but requires a large number of assumptions to implement. To estimate liquidation value for the organic chemicals sectors, the EPA relies on equations that, while plausible, appear to be arbitrary and are not supported by evidence in the Organic Chemicals Study. To determine the salvage value of a plant, the Organic Chemicals Study used the following equation:

$$LV = 0.2 \times FA + RE + WC$$

where:

LV = liquidation value
FA = fixed assets ("Fixtures and Equipment" from Dun &Bradstreet)
RE = real estate ("Other Fixed Assets" from Dun &Bradstreet)
WC = working capital

The Non-Ferrous manufacturing and the Inorganic Chemicals Studies each used quite different equations to estimate liquidation value. The EPA reports do not indicate why different equations are used in different studies.

Furthermore, the cash flow analysis requires forecasts of the future sales and production volumes of an industry. Some EPA studies have got around this problem by calculating an industry's net income over the recent past, and assuming that its income would have remained constant in 'real' terms over the longer term. These analyses specifically exclude consideration of shorter-term business cycle effects.

### Community Impacts

EPA's analyses may also look at the "community impacts" that result primarily from employment and earnings losses as a result of plant closings. Direct impacts from pollution control regulations, such as plant closures or reduced production levels, can be expected to have direct and indirect impacts on the affected community. In the case studies which were examined by the consultants, community impacts were examined by the EPA when specific

firms were forecasted to close. For example, community impacts were examined in the Organic Chemicals Study and not in the Foundries Study because the model plants which were estimated to close in the latter study did not have a real location.

To assess community impacts, the analysis first looks at economic data for the geographic areas in which the proposed regulation is expected to close one or more plants. The analysis determines:

- the population of the community or metropolitan area and the accessibility of other populous areas;
- the percentage of the community's population that would be affected by the closure(s); and
- the unemployment rate in the community.

The significance of community impacts is determined by the ratio of employment lost from plant closures to the population of the community. For one study, based on U.S. Department of Labor statistics and other data, EPA determined that communities in which employment loss is 0.44% or greater as a result of plant closures are considered to be significantly impacted.[1] If impacts on a particular community are estimated to be significant, then secondary effects are assessed (e.g., changes in earnings, average household income) using standard multiplier analyses.

### "Cost-Effectiveness" Analysis

Many of EPA's regulatory analyses assess not only economic achievability, as indicated by plant closures and job losses, but also other economic impacts. For example, the Office of Management and Budget requires EPA to look at the "cost- effectiveness" of proposed regulations. (This is a different use of the term "cost-effectiveness" than that defined in Chapter II). Essentially, EPA conducts the cost-effectiveness analysis which is required by the OMB by:

- developing abatement cost functions (these show the lowest cost combinations of abatement technologies required to achieve final effluent loadings);
- identifying the socially optimal level of abatement, either judgementally or based on an explicit benefit-cost analysis.

---

1 See "Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Organic Chemicals, Plastics and Synthetic Fibers Industry", U.S. Environmental Protection Agency, September 1987 (page 3-33) for a discussion of the derivation of this value.

- comparing the incremental cost of the control measures to the incremental improvement in environmental quality associated with moving from a point below the socially optimal abatement level to the social optimal level.

The results of the "cost-effectiveness" analysis are often presented along with other information related to technical feasibility in the development document that accompanies each effluent guideline. In some cases, this information is presented along with the results of the economic impact analysis.

If the incremental cost of reaching the socially optimal level is high relative to the incremental benefits, the EPA may reduce the required abatement to a more "cost-effective" level.

This "cost-effectiveness" analysis, however, does not deal with the issue of "economically achievable", or other distributional considerations, per se. Thus, we do not explore it further.

EPA usually prepares an economic impact analysis (or regulatory impact analysis, as required under Executive Order 12291) that considers both economic achievability (as measured by plant closings and job loss) and cost-effectiveness (as defined above). The economic impact analysis may include other measures of impact, such as price changes and effects on foreign trade.

## Municipal Sector

The concept of affordability for municipal owners and operators of environmental facilities (for example, solid waste landfills and sewage treatment plants) has received considerable examination in the United States in the last few years. Much of this examination has been related to more stringent requirements that have been imposed or are being considered for wastewater treatment and solid waste management facilities (in connection with regulations proposed under the Clean Water Act, the Resource Conservation and Recovery Act, and the Superfund Amendments and Reauthorization Act). Several studies have attempted to define "affordability" or "ability to pay" at the municipal level, and provide measures that could be used to assess whether a standard is economically achievable for public entities.[1]

However, while there has been considerable exploration of the concept of "ability to pay", the EA concept per se has not been applied to the municipal sector. As noted previously, explicit reference to the concept of EA is found

---

1 See, for example, "State Assistance for Public Facilities: Determining Local Ability to Pay," Council of State Community Affairs Agencies, February 1987; Financial Capability Guidebook, U.S. Environmental Protection Agency, March 1984.

only in the Clean Water Act, and it is to be used in setting effluent limitations for categories and classes of point sources. To date, EPA has established effluent guidelines for a number of industrial sectors, using the EA concept. However, similar guidelines have not been developed for the municipal sector, within the EA context.

The EPA has attempted to assess municipal affordability or a municipality's ability to pay for a number of environmental protection measures. The Office of Drinking Water uses affordability measures to determine the impact of drinking water standards on households. The Office of Solid Waste uses affordability criteria in setting planning and operating requirements for municipal solid waste facilities (e.g., resource recovery facilities and sanitary landfills) under the Resource Conservation and Recovery Act. The Office of Underground Storage Tanks uses financial parameters in setting financial assurance requirements for public owners of underground storage tanks.[1] The Office of Municipal Pollution Control uses affordability criteria to determine whether a municipality can pay for waste water treatment projects[2]. The EPA may provide technical or financial assistance, or stretch out the compliance schedule, for municipalities than cannot pay.

Measures of affordability for the public sector differ from those for the private sector. In the public sector, measures such as many financial ratios and discounted cash flow analysis are not meaningful because of differences in accounting practices in the public sector and the absence of the profit motive. Instead, affordability or ability to pay is measured in terms of the burden a requirement places on the municipality relative to the municipality's wealth and available resources, or relative to the burden in comparable municipalities.

Thus, the guidelines in The Financial Capability Guidebook of the EPA[3] suggest procedures for evaluating (1) a community's financial condition and (2) annual costs per household. While these procedures were intended to be applied on a project-specific basis (that is, to determine whether a community could afford to pay for a proposed facility), many of the measures suggested here could be used to assess economic achievability across a number of affected communities for a proposed standard. Each component of the guidelines is described in greater detail below.

---

1 Information provided by Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency.

2 Financial Capability Guidebook, U.S. Environmental Protection Agency, March 1984.

3 Financial Capability Guidebook, U.S. Environmental Protection Agency, March 1984.

## Evaluating a Locality's Financial Condition

EPA uses 11 quantifiable indicators to evaluate local financial conditions. For each indicator, the guidelines include a set of standards that identify whether the indicator reflects a weak, average, or strong financial condition. These standards are based on national figures. Calculating all 11 indicators should provide a fairly accurate assessment of a locality's overall financial strength; EPA guidelines do not, however, specify how many indicators are needed to confirm that a community's overall financial condition is weak, average, or strong. The indicators could also be calculated with and without the proposed project. This would indicate whether a community's fiscal problems are due to the proposed project or are inherent in the locality's current fiscal condition. Exhibit III-4 provides a description of each indicator and the standards that correspond to a weak, average, or strong financial condition.

## Determining Annual Costs Per Household

In addition to assessing a community's overall financial strength, EPA guidelines also measure the burden a proposed facility places on the community. This is most often measured on a per-household basis to reflect the amount households would have to pay through increased user fees or taxes for the new services. Capital costs and one-time expenses are annualized using an appropriate interest rate, useful life, and recovery factor. These costs are added to annual operating expenses. In these calculations, the share of costs borne by industrial and commercial users, and any income from the sale of by-products, is then deducted from total facility costs. The total residential share of annual costs, which is what remains, is then divided by the number of households expected to use the facility.

Over the last ten years, EPA has developed measures for assessing per-household costs (similar to the standards for the financial condition of a locality) which, if exceeded, suggest that the burden the proposed facility places on the community is too great. There are several ways to express this burden (for example, as a percent of annual income or as an absolute value), and different programs within EPA have used different threshold values, depending on the program area and what is considered a "reasonable" expense. (This is an area that is still evolving in the United States; furthermore, the selection of threshold values may reflect political considerations in addition to economic factors.) Exhibit III-5 lists the values used by several EPA offices to assess ability to pay. As the table illustrates, different programs use different indicators and values for determining impacts.

It should be noted that, in most cases, EPA's analyses of individual regulatory requirements do not take into consideration the cumulative impact of various environmental regulations on households or on municipalities. At least two

EXHIBIT III-4

MEASURES OF U.S. MUNICIPAL FINANCIAL CONDITIONS

| Indicator | Weak | Average | Strong |
|---|---|---|---|
| Population growth (annual rate of change in population over past five years) | < -1% | -1% - +1% | > +1% |
| Operating surplus/deficit (total current general fund revenues minus total current general fund expenditures, divided by total current general fund expenditures) | < 0% | 0% - 5% | > 5% |
| Property tax collection rate | < 96% | 96% - 98% | > 98% |
| Reliance on property tax revenues | > 4% | 2% - 4% | < 2% |
| Overall net debt as percent of full market value | > 5% | 3% - 5% | < 3% |
| Overall net debt as percent of personal income | > 12% | 4% - 12% | < 4% |
| Direct net debt outstanding per capita | > $750 | $250-750 | <$250 |
| Overall net debt outstanding per capita | > $1000 | $450-1000 | < $450 |
| Direct net debt due within five years as percent of direct net debt due | < 10% | 10% - 30% | > 30% |
| Operating ratio of sewer enterprise (estimated operating revenues divided by estimated operating expenses) | < 100% | 100-125% | > 125% |
| Coverage ratio of sewer enterprise (estimated total revenues minus operating expenses, divided by annual debt service on bonds) | < 120% | 120-170% | > 170% |

Source: Financial Capability Guidebook, U.S. EPA, March 1984.

EXHIBIT III-5

MEASURES OF U.S. MUNICIPAL ABILITY TO PAY

| Office | Ability-to-Pay Measure | Limit |
|---|---|---|
| Office of Municipal Pollution Control | Total annual cost per household | > $250 |
| | Total annual cost as a percent of median household income, where | |
| | – median income < $10,000 | > 1% |
| | – median income $10,000-17,000 | > 1.5% |
| | – median income > $17,000 | > 1.75% |
| | Increase in household cost of an upgrade or expansion over existing household cost | > 20% |
| Office of Solid Waste | Total annual cost as a percent of total municipal expenditures | > 1% |
| | Total annual cost per household | > $220 |
| | Total annual cost as a percent of median household income | > 1% |
| Office of Drinking Water | Increase in annual fees as a percent of median household income | > 1% |
| | New total annual fees as a percent of median household income | > 2% |

Source: Brett Snyder, Office of Policy, Planning and Evaluation, U.S. EPA, October, 1989

studies have attempted to look at the combined burden of all environmental requirements.[1,2] In addition, a working group is now being formed to examine the different measures being used by the program offices to assess ability to pay and the issue of cumulative impacts.

## EPA Municipal Ability to Pay Models

The EPA has developed two models to assess the ability of municipalities to pay for various environmental services. The two models are entitled:

- MUNFIN, and
- MABEL

Both models are still under development within the EPA and not in general usage. Both are currently in the process of undergoing an extensive review panel.

The purpose of MUNFIN is to take a comprehensive look at the burden on municipalities of all EPA regulations. This computer-based model, developed from a database of over 300 municipalities selected nation-wide, is used to prepare fairly detailed analysis of the impacts on municipalities of environmental regulations pertaining to water, waste water, solid waste, hazardous wastes, toxics, air quality, marine and estuarial water quality, and construction grant programs. MUNFIN analyzes the resulting financial impact on the municipalities and attempts to determine whether or not local governments can pay for the increased expenditures by raising user charges, and by issuing revenue and general obligation bonds.

The MABEL model relates specifically to all publicly-owned treatment works in the U.S. (POTW's). The purpose of MABEL is to ascertain the financial ability of a municipality to finance the following major capital projects; build a POTW, upgrade an existing facility, or build facilities to treat drinking water. Because it will be used in enforcement proceedings, the model also evaluates whether or not the municipality can pay a proposed penalty. The model's framework parallels the decision-making process of bankers who lend money to municipalities. Furthermore, the model addresses the regulatory and fiscal realities of the communities and helps negotiate compliance schedules.

---

1 "The Municipal Sector Study — Impacts of Environmental Regulations on Municipalities," Office of Policy, Planning and Program Evaluation, U.S. Environmental Protection Agency, September 1988.

2 "The Cost of Environmental Protection: EPA, the States, and Local Governments," Prepared by Apogee Research for the Office of the Comptroller, U.S. EPA, April 1989.

The development of the model was based on an extensive literature review, and interviews with local government financial officers, fiscal advisors, and credit rating analysts. MABEL evaluates the ability of sewer customers to pay increased user charges, of the sanitary district to issue revenue bonds, and of the local government to issue general obligation bonds. MABEL's threshold values include three ratios:

- user charges to user income;
- debt service to real property value; and
- debt service to income

MABEL is currently undergoing a peer panel review.

## Information Needs

In the United States, preparation of an economic impact analysis for a major rule-making is a considerable undertaking. A sense of the level of effort required is obtained from reviewing the case studies in Appendix A. The economic impact analyses for these studies were conducted at a cost of over half a million dollars each. The economic impact analysis employs data from many sources at differing levels of aggregation. Wherever possible and appropriate in the analysis, data drawn directly from the regulated plants or firms are used. However, in cases where the information is not directly available or suitable, aggregate or publicly available data are used.

The U.S. Environmental Protection Agency collects data for its economic impact analyses from a variety of sources. For those regulations promulgated under the Clean Water Act of 1977, the Agency has specific authority (under Section 308) to conduct a survey to collect technical, financial, and economic information.[1] For other regulations, the Agency must rely on more general authority under the Administrative Procedures Act to collect information. The Agency also relies heavily on publicly available sources of information for financial data, such as Dun & Bradstreet and Standard and Poors.

EPA has exercised considerable discretion in its use of Section 308 authority to collect financial information from plants and firms. In the 1970s,

[1] It should be noted that EPA is not required to conduct a survey whenever it promulgates a regulation under the Clean Water Act, nor to include questions regarding financial information in its survey. EPA's decision of whether to conduct a survey, and the information to request, depends on the number of facilities or firms potentially affected by the regulation, the amount of information already available, and political considerations.

the survey was used extensively to collect both engineering and financial data. In the early 1980s, however, the Agency dropped many of the finance-related questions from the survey, partially in response to industry objections and because the Agency felt that sufficient financial information was available in the public domain. Based on its experience with several of the major rule-makings in the 1980s, the Agency decided to go back to relying on its authority under Section 308 to collect financial data. The Agency found, for example, that in setting effluent guidelines for the organic chemicals industry it had to extrapolate much of the plant-level data from industry averages, because plant-level data were not publicly available.

The remainder of this section describes the information needed to assess the effects of effluent guidelines on an industry. It is intended to illustrate the type of information and level of detail typically required for such an analysis.

## An Example – Assessing The Effect Of Effluent Guidelines

Inputs to the analysis consist of:

- a description of industry baseline financial and operating conditions;
- cost of compliance with effluent guidelines; and
- cost of compliance with other regulatory programs.

The cost of compliance calculations are relatively straight forward. The industry baseline description is derived from data collected through an EPA survey, which is conducted pursuant to Section 308 of the Clean Water Act (the Federal Water Pollution Control Act, 33 U.S.C. 1251 et seq., as amended). This Section grants the EPA the authority to conduct a survey requesting mandatory technical, financial, and economic information from industries. Part A of the questionnaire is designed to collect data on manufacturing activities and waste treatment practices; part B requests financial and economic information from the firms. When technical and financial information is requested, all firms are obligated to respond for the most recent, present, and next calendar years. The EPA does not always conduct a survey when formulating new regulations. Likewise, when a survey is conducted, EPA may request only technical information from the regulated firms.

All records, reports, or information supplied to the EPA may be made public by the EPA if the information is not accompanied by a business confidentiality claim. The business confidentiality claim may cover part or all of the information submitted, other than effluent data. Information covered by the claim of confidentiality may be disclosed to other employees, officers, or authorized representatives of the United States concerned with the proposed regulation. Effluent data are not eligible for confidential treatment.

Part B of the 308 Survey requests total dollar value information from the firm for assets, liabilities, and equity. Assets and liabilities are subdivided into current and non-current categories. Current assets include assets that are reasonably expected to be converted to cash, sold, or consumed during the year—such as inventories, cash, accounts receivable, and prepaid expenses like rent, operating supplies, and insurance.

Non-current assets include physical items like property, plant and equipment, long-term investments, and intangibles. Current liabilities include all accounts payable, accrued expenses and taxes, and the current portion of the long-term debt that falls due for payment within the year. Non-current liabilities and equity are payments to be made beyond the calendar year and include long-term debt such as bonds, debentures, bank debt, and deferred income taxes, and owners' equity (the difference between total assets and total liabilities).

In addition to balance sheet information, the 308 Survey requests income statement information on revenues and expenses. Wherever possible, information should be provided at the facility level; however, where facility-specific data are unavailable, the respondent may rely on firm-level data. Revenue information requested includes: the total sales value of all products manufactured; revenues generated from contract work done for other facilities or firms; and other revenues not reported in the first two categories. Expenses include both manufacturing and facility costs. Manufacturing costs include: direct materials, direct labor and indirect costs that were either put into production, used as operating supplies, or used in repair and maintenance. Facility costs include: depreciation on buildings, plant, equipment and machinery; fixed overhead, research and development; interest payments; federal, state, and local taxes; and any other non-recorded expenses.

Additional firm-level financial data are publicly available from sources such as Dun & Bradstreet's Financial Profile (D&B) database. By editing the D&B records to include only single-location firms, it is possible to obtain a proxy for plant-level data. The danger is that plants within multi-plant firms may have different characteristics than the plants corresponding to single-location firms. The edited D&B data may not, therefore, be representative of the industry as a whole.

Financial information at the firm level is also available from COMPUSTAT.[1] Data and forecasting models are needed to provide product-specific economic information, industry statistics, and macroeconomic data (e.g., trends in production, employment, overall economic growth or decline). Macroeconomic data are supplemented by information provided from the

[1] COMPUSTAT information is taken directly from the Form 10-K reports submitted by publicly owned companies to the U.S. Securities and Exchange Commission.

Bureau of Economic Analysis (BEA) and Bureau of Labor Statistics (BLS); the Bureau of the Census provides additional industry data.

Exhibit III-6, shows, in greater detail, how these data sources and the information requested is integrated into the impact assessment for the chemical industry. The important analytical components are presented in the center of the figure. Data sources, databases, and models are shown on the left-hand side of the figure.

When "model plants" are created to represent industrial subcategories of an industry, additional information is needed to group the firms. The information necessary for these subcategories is plant specific and includes: employment size, discharge mode, type of firm (jobber or captive), degree of vertical and/or horizontal integration, financial status, and specific product manufactured. In the past this information has been included in the Section 308 Survey.

## Exhibit III-6

Flowchart of Information Flow and Analysis: Chemical Industry

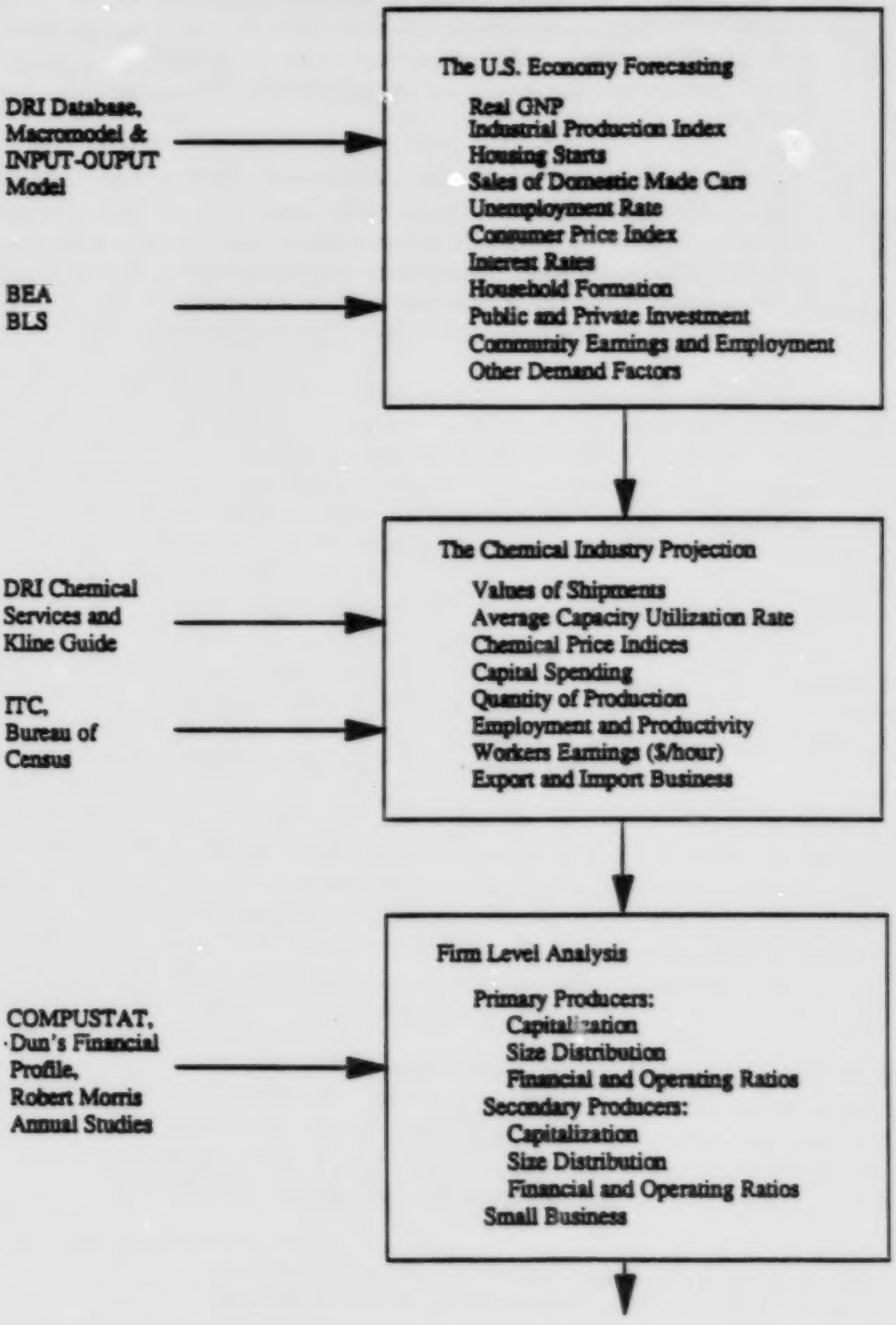
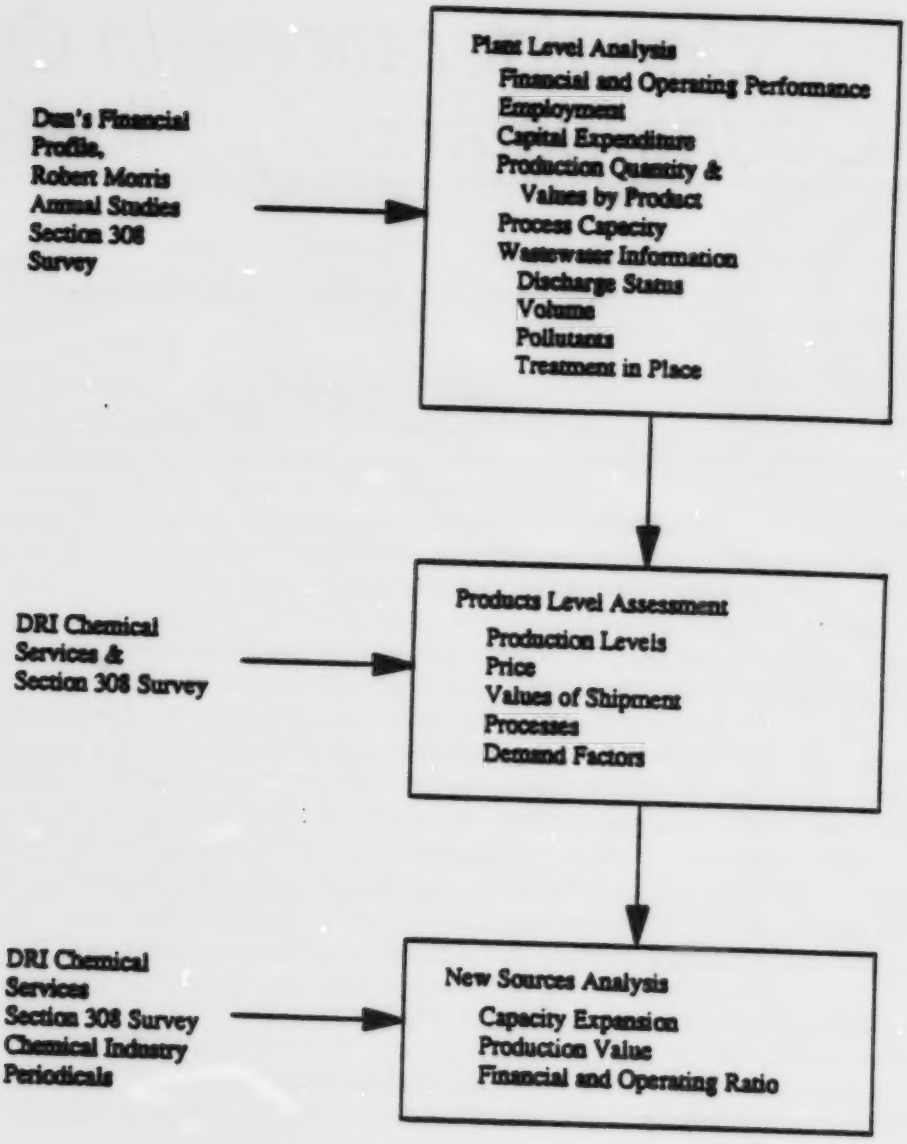


EXHIBIT III-6 (cont'd)

Flowchart of Information Flow and Analysis: Chemical Industry (cont.)



# IV - Distributional Considerations In Other Countries and Applications

In this Chapter, we describe how distributional considerations are dealt with in three areas:

- environmental applications in Canada;
- environmental applications in OECD countries; and
- selected non-environmental applications in Canada and the U.S.

The phrases "economically achievable" or "economic achievability" are, to our knowledge, not directly used in any of these applications. Instead, we consider how concepts similar to EA are used.

The focus of Chapter III was on the use of the EA concept in the setting of standards for categories and classes of point source dischargers. The research for that chapter has not focused on issues that may be of relevance to individual dischargers and their unique circumstances. However, in the work described in this chapter, we have not maintained this distinction. This is because, particularly in the Canadian context, the "affordability" concept has often been applied in a retrospective context based on individual firm circumstances. In other words, rather than being used prospectively to define and set standards, the E.A. concept has often been used retrospectively, once regulations have been put in place, to deal with individual firm circumstances. The E.A. concept has also been used in Canada to help determine what standards are set, and these cases are also discussed in this chapter

The research underlying Chapter IV has been much less intensive than that underlying Chapter III. The intent was to identify other examples of the use of the EA concept, or related concepts, rather than to obtain a comprehensive and detailed understanding of all such uses.

## Canadian Environmental Experience

To understand how economic achievability entered into the setting of environmental legislation across Canada, we contacted individuals from:

- Environment Canada,
- Ontario Ministry of Environment,
- British Columbia Ministry of the Environment,
- Alberta Department of Environment and Energy Resource Conservation Board, and
- Quebec Ministere de l'Environnement.

The discussion which follows describes, for each jurisdiction:

- if and how the EA concept, or related concepts, are defined, and
- how analysis of distributional issues is used in the setting of environmental standards and objectives.

## The Federal Government

In 1986, as part of the federal regulatory action plan, the federal government required Regulatory Impact Analysis Statements (RIAS) to be carried out on all regulations which were to be considered for approval.[1] An important part of regulatory impact analysis is the anticipated impact section, which calls for cost-benefit analysis of all new regulations or amendments having a major impact.

As a guiding principle of its regulatory policy, the federal government has stated that it will "ensure that benefits clearly exceed costs before proceeding with new regulatory proposals." Furthermore, it will give "particularly careful consideration to all new regulations that could impede economic growth or job creation". All proposals should take account of their potential impact on small businesses and "ensure that enterprises of different sizes are not burdened disproportionately by the imposition of uniform regulatory requirements".[2]

The federal government recognized that cost-benefit analysis and related techniques could be carried out to varying degrees and that the deeper the analysis, the more time consuming and costly it would generally be. Consequently, a proportionality rule was introduced which called on departments and agencies to determine the appropriate depth and rigour of analysis on a case-by-case basis, with the extensiveness of analysis to be directly proportional to the expected degree of socio-economic impact of the regulatory initiative.

---

1 "The Federal Regulatory Process – A Guide for Departments and Agencies," Office of Privatization and Regulatory Affairs, January 1988.

2 "Regulatory Reform Strategy", Office of Privatization and Regulatory Affairs, 1986.

Thus, in Canadian RIAS, the cost-benefit analyses explicitly incorporate distributional considerations. Specific non-allocative effects to be analyzed include income distribution, and how effects differ by size of firm, by age of plant, and by present plants versus new entrants. Non-allocative effects also include impacts on competitiveness in an industry; whether economies of scale make it cheaper for some firms to comply than others; and whether the regulations will affect barriers to entry. Regional impacts, specifically unemployment, are also to be analyzed, as are the effects of proposed regulations on inflation.

The reform package noted that "regulation is legislation and, as such, will be brought more fully under the control of elected government representatives". Accordingly, when there are trade-offs that have to be made as a result of an uneven distribution of costs and benefits, or other non-allocative effects, the RIAS should confine its role to the documentation of such effects. The decision on the acceptability of such impacts (which may entail job losses or gains, or an increase in regional or economic disparity) must be left up to the minister concerned.[1]

In March, 1989 The Office of Regulatory Affairs Branch published a "Guide to Regulatory Impact Analysis", which was written to assist federal departments and agencies in carrying out the regulatory impact analysis and more specifically, the cost-benefit analysis.

The federal environment department must carry out a RIAS for all proposed regulations. Cost-benefit analyses are carried out on proposed regulations whenever there is sufficient information available to do the analysis.[2] More recent cost-benefit analyses which have been carried out by Environment Canada include regulations on lead in gas[3] and regulations which control ozone-depleting substances.[4] A list of the RIA Statements which have been completed and those underway is given in Appendix C.

## Ontario

The Ministry of the Environment includes an economic component in all of its major program initiatives. Currently, Ontario has economic components to its programs which control toxics in effluents, solid waste , and air pollution. The Ministry of the Environment has a socio-economic group which is respon-

---

1 Personal communication from Jack Korwin, Manager, Economic Regulations, Office of Privatization and Regulatory Affairs.

2 Personal Communication from Michelle Gosselin, Chief, Socio-Economic Analysis Division, Environment Canada.

3 Published in the Federal Gazette, July 15, 1989.

4 Published in the Federal Gazette, November 18, 1989.

sible for undertaking economic analysis as input to the development and implementation of Ministry policies, planning, and research.

For the Municipal-Industrial Strategy for Abatement (MISA), economists at the Ministry have prepared economic profiles of the major industries which will be regulated under MISA. As well, economists are in the process of preparing monitoring and abatement costs of the proposed regulations on industry. In the monitoring studies which have been completed thus far, the Ministry has attempted to address "affordability" of the proposed monitoring regulations within an analytical framework similar to EPA's. A detailed list of the studies which have been completed is available from the Ministry's MISA office.

Economists at the Ministry will also examine financial implications of any MISA regulations on municipalities.

The Ministry's proposed amendments to its air pollution regulation, the Clean Air Program (CAP), provide another example of the work of the Ministry's economists. The costs and benefits of this program were estimated, contributing an economic perspective to the formulation of the regulatory changes.

Another major initiative of the Ministry was the use of economic analysis to estimate the monetary value of the biophysical effects resulting from acid deposition. The APIOS program (Acid Precipitation in Ontario Study) relied heavily on economics as the basis for policy formulation through the determination of the costs and benefits of various options for emission control.

In addition to having an economic component in major initiatives, the Ministry requires an economic impact evaluation when preparing new regulations, policy proposals, or legislation.[1] This evaluation identifies the effects of the proposed regulations, policies, and legislation on the private and public sectors. Allocational considerations are to be addressed through cost-beneffit analyses.

Currently, there are many different procedures for setting pollution control guidelines, objectives, and standards in Ontario. This is due to the fact that these limits are often set by the branch in the Ministry which oversees a particular area of pollution. For instance, the Water Resources Branch of the Ministry sets drinking water standards and water quality objectives, while the Air Resources branch of the Ministry develops air standards. Each branch has traditionally set the standards in different ways.

The Minister of the Environment has established recently an Advisory Committee on Environmental Standards (ACES). The purpose of this committee is to provide the Minister with recommendations on standards for environmental contaminants based on public input and pertinent scientific, legal,

---

1 Ministry of the Environment Policy Manual, Policies 02-01, 02-02, and 02-03.

economic and sociocultural issues.[1] The precise role to be played by economic and financial analyses in the Committees' analysis is yet to be decided.

### The Retrospective Use of Economic Achievability

If firms in Ontario exceed the pollution control standards that the Ministry has in place, or violate the Environmental Protection Act or Ontario Water Resources Act in some way that cannot be rectified quickly, the Ministry will issue a control order or a Minister's order to the firm. Both orders are legally enforceable mechanisms which contain concentrations or emission levels which must be met and dates by which these requirements must be achieved.

If a company states that it cannot afford the control technology required to meet the regulations, Ministry officials have some latitude to negotiate an extended deadline when the control measures must be implemented. If Ministry officials cannot negotiate a satisfactory agreement with the firm, then a financial analysis is undertaken. Initially, the financial analysis is usually done by Ministry officials. If time constraints do not allow MOE staff to do the analysis, then a forensic audit, carried out by an external auditor, is undertaken. A forensic auditor may also be called in if an "impartial" opinion is required.

The type of information which is required in an economic and financial analysis of private sector firms is described in detail under a Ministry of the Environment policy.[2] This policy states that the costs, benefits, and distributional effects of the pollution control requirements be quantified. One example of the application of this policy is a forensic audit which was carried out on a firm in the organic chemical sector. Financial ratios (current ratio, quick ratio, debt to equity ratio, net return on tangible net worth, and rate of return on total assets) were used as indicators of the financial health of the firm, while the distributional aspects of the requirements were taken into account by examining price effects and the effects of the requirements on competition.

The studies of the ecomomic and financial implications to affected firms of MISA's monitoring regulations are other examples of the Ministry's use of economic and financial analyses.

## British Columbia

In the past, the British Columbia Ministry of Environment has not carried out any type of economic analysis during the pollution control objective and standard setting process. There are no legislative requirements for the Ministry

---

1 Ministry document: Advisory Committee on Environmental Standards, ISBN 0-7729-5754-1.

2 Ministry of Environment Policy 02-01, "Guidelines for an Economic Analysis of Private Sector Pollution Abatement and Environmental Protection Measures."

to carry out any type of economic analysis when setting pollution control objectives. However, the Ministry is currently reviewing the standard-setting process for pollution control objectives and, in the future, may require economic considerations to be a factor in their formulation.

The Ministry currently has pollution control objectives for five sectors. The objectives which are in effect now were formulated in the 1970s and were based on the technology available at that time. Currently, the Ministry of the Environment is in the process of reviewing these objectives. In parallel to this, the Ministry is meeting with officials from the Province's Treasury Board to define new evaluation criteria for determining environmental initiatives. Nothing has been codified as yet, although it was suggested by Ministry officials[1] that the criteria would require that a cost-benefit analysis and/or risk analysis be carried out during the objective setting process.

### The Retrospective Use of Economic Achievability

If a firm exceeds the limitations set out in a permit and claims that it cannot afford the technologies which would be required to reach the limits defined in the permit, then the company must request a "variance order" from the Minister. A variance order allows a company to meet the objective required in the permit over an extended period of time. Before a variance order is agreed upon, either a financial auditor is called in to analyze company financial statements or, if it is a public company, Ministry staff review publicly available financial data on the firm. There are no specific decision rules which the Ministry uses to determine whether or not a variance order will be approved.

## Alberta

As a general rule, no economic analysis is carried out by the Alberta Department of Environment when setting environmental regulations. In most cases, when regulations are being formulated which will affect a specific industrial sector, Department of Environment officials meet representatives from the affected industry and negotiate a regulation.[2] Negotiations with industry usually focus on what kind of technology is available to reduce a specific pollutant, and what would be practical in terms of setting a regulation. Regulations are generally based on variations of best available technology, best available demonstrated technology, and best practicable technology.

---

1 Personal communication with Mike Stone, Economist, B.C. Ministry of the Environment and Rick Wilson, Director of Planning and Assessment Branch, B.C. Ministry of the Environment.

2 Based on a discussion with Mr. L. McKibbon, Department of the Environment.

Economic analysis was carried out in one case to determine the possible effects of changes in sulphur regulations on a specific industry. When provincial sulphur recovery guidelines were being reviewed, a task force was set up to determine the economic effects of different regulatory scenarios on sour gas plants. Plants were separated according to tonnes of sulphur input into the plant per day and categorized into small, medium, and large size categories. The analysis showed that small plants in the province would be affected more by changes in the regulation than would medium or large plants, because the type of technology appropriate for use by smaller firms did not leave the sulphur in a state suitable for resale. In responding to the need for regulation and the desire not to unfairly disadvantage the small firms, the Alberta government offset the costs of the regulation through the royalties on resources which the province controls.[1]

### The Retrospective Use of Economic Achievability

If a firm exceeds an environmental standard, a control order is issued to the firm. This order is a legally enforceable mechanism whereby the polluter must mitigate the environmental infraction. If a company cannot meet a standard because of the high costs of technology, an extended period of time for compliance may be negotiated.[2] Financial auditing of a firm's books is currently not done in Alberta.

## Quebec

The Quebec Ministere de l'Environnement does not carry out economic analysis as part of the formulation of environmental regulations. However, after regulations have been drafted, the economic effects of the proposed regulation are examined by economists in the Ministry.

Economists at the Ministry recently commissioned a report[3] which developed a methodology for carrying out economic evaluations for proposed regulations on an industrial sector basis. The report recommended that a number of studies be carried out on proposed regulations. The suggested studies included, among other things, a cost-benefit analysis and an analysis which would examine the distributional effects of the regulations.

The report recommends that these analyses be carried out on all regulations and is similar in approach to the U.S., Canadian federal government, and

---

1 Information on Sour Gas plant review from Kevin Johnston, ERCB.

2 Personal communication with Jerry Lack, Alberta Department of Environment.

3 "Development et Application d'une Methodologie d'Evaulation Economique des Regl...stations Environnementales au Quebec," March 1989, Cogesult Inc.

Ontario models for determining "economic achievability". The report has not yet been formally adopted for use by the Quebec Ministere de l'Environnement; however, it is used by the economists to guide them in their analysis. In practice, the level of analysis which is completed usually depends upon the amount of time the economists are given.[1] No primary data collection is carried out for economic analysis of draft regulations.

Regulation of air, water, and hazardous waste in Quebec is done under the Quebec Industrial Waste Abatement Program. The main thrust of the water regulations is to remove toxics using best available technology. The Ministry has accepted the principal of best available technology economically achievable; however, it has not yet defined it. As in Ontario, industries in Quebec are being regulated on a case-by-case basis. According to one source at the Ministry,[2] the concept of "economic achievability" will be defined on an industry-specific basis.

Currently, an economic analysis of the pulp and paper industry is examining the costs and benefits of complying with environmental regulations. The analysis includes a financial analysis for each company in the industry. Specifically, the Ministry is interested in three financial indicators – return on investment, net income, and annual capital expenditures. Information on companies is from the Statistics Canada Census of Manufacturing, company annual reports, and information on companies prepared by other sources. Economists at the Ministry receive financial data on a plant by plant basis from Statistics Canada, after requesting permission from the firms involved.

### The Retrospective Use of Economic Achievability

On rare occasions, if a firm states that it cannot afford an environmental regulation, a forensic audit is carried out. The audit is conducted by economists in the Ministere de l'Environnement and confidential company financial statements are used. The province of Quebec has no legislative authority to request these financial statements and Ministry officials usually sign confidentiality agreements before the company will volunteer them.

The most detailed audit that the Ministry has carried out was for Noranda Inc. In regulating Noranda, the Ministere de l'Environnement wanted to find out if the proposed regulations would cause financial harm to Noranda. If it was shown that financial harm would be caused, the Ministry wanted to determine what level of financial assistance would be most effective in compensating Noranda.

---

1 Personal communication with Claude Sauve, Economiste, Ministere de l'Environnement, Quebec.

2 Claude Sauve, Gouvernement du Quebec, Ministere de l'Environnement.

Since the regulations dealt with $SO_2$ emissions at one particular smelter, economists carried out a discounted cash flow analysis at the smelter, assuming the plant was a profit centre. Using a computer model and sensitivity analysis, the economists were able to suggest the optimal level of government assistance which would ensure Noranda would not close the plant. This detailed financial analysis was carried out for the plant only. However, implications of the analysis were incorporated into the overall strategy for Noranda as a conglomerate so that a corporate perspective on the investments could be analyzed.

### Conclusions

In Canada, the concept of economic achievability has generally not been formalized. In several jurisdictions, evaluation of environmental regulations includes a consideration of costs, benefits, and distributional effects. However, the approach to measuring distributional considerations is not as well developed as it is in the United States, nor are these approaches consistent across jurisdictions.

## *Environmental Experience in OECD Countries*

This section describes use of "economically achievable" or "affordable" concepts in pollution control and abatement programs in selected OECD countries—mainly Japan and member countries of the European Community (EC). The term "economic achievability" in this review is confined to cases in which application of environmental regulations entails consideration as to whether or not:

- the polluter can afford to comply with the regulation, and/or
- the regulatory standard or charge entails excessive costs.

Most OECD countries use some combination of effluent or discharge standards based on best available technology and ambient water and air quality standards to implement environmental policy. Several other OECD countries use a "Best available technology" (BAT) approach to regulate pollution control activities. In addition, several European countries levy effluent charges on polluters. Economic achievability considerations enter into setting 1) the stringency or level of discharge standards based on best available technology and ambient air and water quality goals and 2) effluent tax amounts. Environmental planning procedures also address economic considerations in several countries, notably in Japan.

Economic achievability considerations are included or are manifested in the following ways (examples are given later in this section):

- Explicit concern stated in legislation or included in the regulation making process about costs and cost impacts (the "affordability") of pollution control regulations. Economic achievability considerations are stated as a goal in some OECD countries' environmental legislation. However, measurable economic achievability criteria are generally not included explicitly in legislation or regulations.

- Implicit concern about the costs of regulation included in a consensus building process that occurs between government and industry (or municipalities) in establishing regulations.

- Government/private sector planning processes to establish "rationalized" and efficient industrial siting and environmental controls.

- Exemptions from or less stringent regulations for hardship cases.

- Effluent charges based on the "polluter pays" principle (defined in a subsection below) and revenue generation objectives that redistribute the charges in the form of subsidies for pollution control equipment to make regulations economically achievable or acceptable.

- European Community activities.

These are discussed separately below. Typically, the discussion focuses on particular countries which illustrate particular points, rather than being comprehensive.

## Explicit Consideration Of Cost Impacts Of Regulations

Consideration of the economic achievability of environmental regulations is explicitly stated in legislation or policy documents in several OECD countries.

Several directives and policy statements issued by the Council of Ministers of the European Community are binding on member countries.[1] Several environmental directives include language about economic achievability. The

[1] The European Community, formerly known as the European Economic Community or EEC, includes twelve member countries who have signed treaties establishing the EC and who participate in the Council of Minister, Commission, Parliament, and various committees and organization of the EC: Belgium, Denmark, France, the Federal Republic of Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom.

Council Directive 84/360 of June 28, 1984 on air pollution from industrial plants states that the European Commission shall "fix emission limit values for new plants based on the best available technology not entailing excessive costs..." This sentence is restated in Council Directive 88/609 of November 24, 1988 on air pollution from large combustion plants. Excessive costs are not defined in the directives.

The EC Council of Ministers "Recommendation on Cost Allocation and Action by Public Authorities on Environmental Matters" (published in the Official Journal, July 25, 1975) includes exceptions to the polluter pays principle that are justified in limited cases:

> "Where the immediate application of very stringent standards or the imposition of substantial charges is likely to lead to serious economic disturbances, the rapid incorporation of pollution control costs into production costs may give rise to greater social costs. It may then prove necessary to allow some polluters time to adapt their products or production processes to the new standards; and/or to grant aid for a limited period and possible of a digressive nature."

In Great Britain, air pollution control legislation is based on the Control of Pollution Act of 1974 which imposes a general duty to use "best practicable means" to limit emissions. The Inspectorate takes the current state of technology (best available technology), European Communities and national standards and quality objectives, environmental risks, and cost of controls into account when reviewing a scheduled process – that is, a facility requiring a pollution control permit.[1] Cost of controls appears to be determined by financial implications or traditional financial measures on a case-by-case basis. Burnett-Hall (1989)[2], in a review of environmental regulation in Britain, notes that one of the reasons for the meagre enforcement of air pollution controls lies in the fact that many of the most "backward works are those most under-resourced and that are financially incapable of installing the necessary plant. Any enforcement of the law would only result in the closing down of the facilities and unemployment for the workers in it."

Britain's Department of the Environment has proposed a system of integrated cross-media pollution control. Plant environmental permits would be issued after an assessment of all of the polluting emissions from the plant. In setting emission limits, account would be taken of air and water quality objectives, and subject to these, limits would be set by reference to the European

---

1 Scheduled processes are listed in Part A of the December, 1986 Department of Environment publication Air Pollution Control in Great Britain: Review and Proposals.

2 Sources referenced in this section of the report are listed in full in the bibliography in Appendix C.

concept of "best available technology not entailing excessive cost" (BATNEEC).[1] As noted above, the EC Council Directive 84/360 and other Council directives do not define excessive costs or best available technology.

Japan's comprehensive planning process (described in greater detail below) allows regional governments to set effluent limits according to the cost of pollution control in relation to other pollution sources in the area.

## Consensus Between Government And Industry

At the national level, the implementation and enforcement of pollution control laws in Europe and Japan generally reflect a consensus privately worked out between government and industry. Regional and plant specific economic considerations (economic achievability) and environmental objectives both receive consideration in the consensus, consultative, or government persuasion process. The consensus process is more of a political give-and-take between public and private sectors rather than a formal consideration of economic achievability criteria spelled out in a regulation.

The consensus approach in some European countries has resulted in a slow, gradual, step-by-step approach to pollution control that has allowed industries and municipalities time to adjust to new pollution regulations.[2] One of the aims of a gradual approach is to prevent short-term economic shocks and thereby help to make pollution regulations economically achievable. A transitional period concept is included in the European Community "EEC Fourth Environmental Action Programme (1987-1992)" in paragraph 2.4.5.:

> "The Commission will...aim, in its development of environmental measures, to ensure that...enterprises are allowed a reasonable time to adjust to the new standards. Adjustment to new environmental standards can in some circumstances be facilitated by financial support."

In some cases, a practice of negotiation between the regulatory agency and the private company or municipality is formalized (e.g., France's River Basin Agencies) or has worked informally (e.g., prenotification negotiations in licensing procedures in the Netherlands). So-called "covenants" between polluters and authorities on developments in particular regions and "Branchenvertrage" in Germany are further examples of cooperative negotiation and agreements in the interest of environmental policy.[3]

---

1 Burnett-Hall 1989.

2 See Pedersen 1985, Singer 1982, European Commission 1987, International Environmental Reporter, March 9, 1988, Burnett-Hall 1989, and OECD 1989a.

3 OECD 1989a.

In France, environmental policy is most likely to be based on direct regulation and effluent charges defined and applied jointly by government agencies and industry and its representative bodies.[1]

Government regulators and industry have a long history of collaboration in the Federal Republic of Germany. Effluent and emission limits and pollution charges are "the result of a compromise between environmental protection and financial interests".[2] Simonis (1987) indicated that the first federal German environmental program in 1971 was strongly based on the "polluter pays principle" but was modified from the start by the criterion of "economic feasibility." Simonis uses the term "economic feasibility" to describe the cost considerations raised by industries and municipalities. Germany's water pollution effluent charge illustrates the influence of industries and municipalities on the establishment of the charge rate.[3] A panel of experts in 1974 recommended a charge of 80-100 DM per effluent unit; a 1972 federal government draft proposed 40 DM; and industry and municipalities asked for no charge or one under 20 DM. In 1981, the charge was established at 12 DM. Pressure from industry and the Lander (states), which asked for more time to develop implementation programs, led to a slow progression of the rate from 12 DM to 40 DM in 1986.

Critics contend that a consensus approach gives undue influence to polluters and has led to the slow adoption of environmental regulations.[4]

## Planning Process

Japan's environmental policy strives to promote both environmental protection and economic development. The requirement for "comprehensive planning" in the 1967 Basic Law for Environmental Pollution Control as amended reflects this philosophy. Area-wide plans are developed that consider urban planning, industrial siting, capital expenditures for wastewater treatment facilities, methods to transfer industry from high-density to low-density regions, and conflicts with other localities.

The law delegates authority to regional governments giving them wide latitude in assigning limits for individual pollution sources. Limits can be set according to cost of pollution control in relation to other pollution sources in the area. Economic incentives such as tax breaks, expedited permits, loans for pollution control, the construction of public facilities, and special grants are frequently used to enforce discharge permits.

---

1 Ibid.
2 Kuhling 1987.
3 See Brown and Johnson 1983.
4 Op.Cit. Pedersen 1985.

## Exemption For Hardship Cases

Federal Republic of Germany federal water pollution Effluent Charge Law provides for the possibility of exemption if considerable adverse economic effects are expected (hardship case). The federal government may pass laws exempting industries, sections of industries, or regions from the charge in instances where imposition of the effluent charge would result in significant detrimental economic conditions. Brown and Johnson (1983) reported that eleven industries had petitioned for exemptions as of 1983; at the time of their report, seven were denied, the others were pending. Although the hardship clause has yet to be used, it was thought by many interviewed to have been an important element in the political process leading to the enactment of the legislation. Criteria for assessing hardship are not spelled out in the Act.

## Polluter Pays Principle, Pollution Charges, And Subsidies

The European Communities and the OECD have adopted the polluter pay principle in their documents stating that the costs of preventing and eliminating nuisances must in principle be borne by the polluter. OECD recently conducted country case studies and analyses of effluent charge programs in OECD countries.[1] Although all European governments apply direct regulations to polluters, effluent charges reflecting the polluter pay principles are a major part of environmental regulation in several countries. France, Germany, Italy, the Netherlands, and Australia apply waste water effluent charges. The only effluent charge applied for air pollution is in France. Pollution charges and applications of the polluter pays principle can in theory be designed to induce polluters to reduce pollution to economically optimal or efficient levels. The efficient level would take into account both private and social costs.

In practice, pollution charges in the European countries that employ them are not set high enough to provide a major incentive to reduce pollution. Effluent and emissions taxes are collected to fund the regulatory agencies that administer the charge program and to provide subsidies (redistribute the taxes back) to polluters to adopt pollution control technologies. The subsidies play a large role in making the environmental regulations economically achievable, or at least politically and economically acceptable.

## Role Of European Community

Environmental regulation in Europe is becoming a European-wide activity for several reasons:

---

1 See OECD 1989a; 1989b.

- Environmental impacts cross frontiers;
- The impetus for stricter regulations is coming from European Community (EC) directives; and
- The Single European Act (1986) which has amended the Treaty of Rome (the "1992 process") has given more power to the European Communities institutions to set and enforce standards and has provided another impetus for member countries to harmonize their environmental standards.

A concern about "excessive cost" is stated in several EC directives (see discussion above).

In addition to pollutant or industry specific directives, the Single European Act of 1986 (which reflects the EC's effort toward closer integration by 1992) may require the harmonization of member country environmental rules and stricter standards. However, because of different national standards and practices, achieving agreement on harmonization of EC-wide environmental standards may be difficult and poses questions of economic achievability. Economic achievability in this case refers to international competition and competitive advantages due to differing national environmental regulations.

New EC legislation may be written to the strictest standards present in member countries or else the EC may have to encourage some countries to lower their standards in the interest of harmonization. Alternatively, the EC could adopt ambient air and water quality standards, leaving producers to adopt different emission levels as long as the air and water in the member country meets the ambient standard. In the past, progress toward EC-wide action has often been dictated by the pace of the member country slowest to adopt environmental controls. The process of implementing the existing EC air pollution directives and of harmonizing environmental standards as part of the 1992 process may impose significantly different economic impacts on member countries.[1]

## Conclusion

Economic achievability considerations are addressed in a number of ways in OECD countries outside North America. The counterpart of "economically achievable" is often stated in terms of "affordability"[2], or "without excessive

---

1 See The Economist, May 6, 1989.

2 See "The Regulation of Industrial Toxic and Hazardous Emissions in Ontario as Compared with Selected Jurisdictions", Ontario Ministry of the Environment, January 1990" for details on the economic and financial impacts of regulations on selected industries.

costs". While it is clear that such considerations have played a major role in both the definition and enforcement of environmental standards, typically the concepts have not been operationalized, either in regulatory practice or in specific cases, in a way which permits us to identify specific EA definitions in a fashion which is useful for this study. This is not to suggest that, with more detailed research beyond the scope of this study, it would be impossible to develop such definitions, but rather that they are not available through the limited literature search and discussions which we have undertaken.

## Economic Achievability In Non-Environmental Programs

The remainder of this chapter examines the application of concepts similar to EA in the context of non-environmental concerns in Canada and the U.S., including:

- occupational health and safety in the U.S.;
- U.S. regulations for access for the disabled;
- Canadian health and safety and product liability laws;
- Canadian trade remedy practice.

### U.S. Occupational Safety And Health Administration

In the United States, the Occupational Safety and Health Administration (OSHA) considers "economic feasibility" as part of its rulemaking process when setting worker exposure limits for various substances (for example, toxics and carcinogens). Economic feasibility is essentially defined as plant closures.

Whether or not a plant will close in response to a new requirement is based on an assessment of the plant's and/or firm's profitability. The economic analysis is comparable to those conducted for EPA rulemakings, in which OSHA estimates the costs of control for various exposure limits. Post-compliance cash flows are then compared to profitability for the firm or the industry as a whole.

Historically, health considerations were paramount in OSHA rulemakings. Economic feasibility, and for that matter technological feasibility, were of lesser concern. OSHA 's opinion was that rules would be "technology forcing" – that is, industry would find a way to comply with the new standards. If it could not, or if the costs of complying were too great, then firms would choose to close.[1]

---

[1] Based on discussions with Dr. Henry Beale, Microeconomic Applications, Inc., January 1, 1990.

More recently, economic feasibility has gained influence in the rulemaking process. There are, however, no hard and fast decision rules about what constitutes "closure." Initially, OSHA took the position that virtually every penny of profit could be spent on compliance, suggesting a threshold value of zero or close to zero profitability before a firm closed. OSHA recognized, however, that some firms would choose to close if their profitability fell too low relative to the industry's profit rate as a whole. As a general rule, OSHA expects that a firm will close if compliance costs cause the firm's profitability to drop into the bottom quartile of the profitability range for its industry.

Like the EPA analyses, each OSHA analysis is very industry-specific. Industries differ in terms of their average return on investment, so what might be considered an unacceptable return in one business may be the norm in another. Other factors such as business cycles, competitive structure, and foreign competition are also taken into consideration. For example, if an industry is in a slump and its financial prospects are poor, the regulation would have no effect on plant closures (since they would close anyway).

OSHA also considers distributional aspects, in accordance with the Regulatory Flexibility Act. Here, OSHA is concerned primarily with the impacts on small businesses – that is, whether they would experience a disproportionate number of plant closings which would lead to a restructuring of the industry. Again, the procedures for a regulatory flexibility analysis are similar to the procedures used by EPA.

## U.S. Requirements For Firms To Provide Reasonable Accommodation

In the United States, the Rehabilitation Act of 1973 was put into effect to ensure that federal government contractors did not discriminate against people with disabilities. Companies were required not to discriminate unless the costs of complying with non-discrimination created undue hardship for the firm.

A new bill – the "Americans with Disabilities Act of 1989" – was passed in 1989. This bill was established to provide a clear and comprehensive prohibition of discrimination on the basis of disability. The bill applies to all employers and is not specific to government contractors.

The Act has five titles which regulate various places or scenarios where individuals might be discriminated against. Each title requires those regulated to provide conditions or facilities to ensure that individuals are not discriminated against. In each case, those being regulated are offered the defense of not being able to afford the changes which would be required by the regulation.

For example, in the Employment title (Title I), employers are required to provide reasonable accommodation for the disabled. However, an employer also has access to the defense of undue hardship, defined as action requiring significant difficulty or expense. In determining whether an accommodation would impose an undue hardship on a covered entity, factors to be considered include:

- the overall size of the business with respect to the number of employees, number and type of facilities, and the size of the budget;
- the type of operation maintained, including the composition and structure of the workforce; and
- the nature and costs of the accommodation under the Act.[1]

Undue hardship is not to be determined solely on the basis of the resources and characteristics of the parent entity, but also on the basis of the resources of the site where the request for reasonable accommodation originated.[2]

Title II – Public Services – requires that no individual be discriminated against while using public transportation provided by public entities. This title requires that paratransit be provided to individuals with a comparable level of service to fixed route public transportation unless the provision of the services would impose undue financial burden on the public transit entity. However, "undue financial burden" is not defined.

Under the Public Accommodations and Services Operated by Private Entities title, those regulated must not discriminate to the extent that the required expenditures are "readily achievable". In the Act, "readily achievable" means easily accomplished and able to be carried out without much difficulty or expense. The determination of whether an action is readily achievable is similar to the determination of undue hardship in Title I.

The Telecommunications Relay Services title refers to undue burden and allows extension of the compliance date for one year if undue burden is shown.

In summary, there are no hard and fast rules for "undue hardship", "readily achievable", "undue financial burden", and "undue burden". These phrases are used as a defense by those regulated, and are determined on a case by case basis at the site where the regulations are required.

---

1 The Americans with Disabilities Act, Section 101,9b iii.

2 In Minutes adopted by the Owens Subcommittee for H.R.2273 the Americans with Disabilities Act, Adopted by the Committee on Education and Labor on November 14, 1989.

## Occupational Health And Safety And Product Liability In Canada

We explored the use of the EA concept, or related concepts, in Canada in the areas of occupational health and safety and product liability, through discussions with representatives of:

- Ontario Ministry of Labour;
- Consumer and Corporate Affairs Canada;
- Transport Canada; and
- Labour Canada.

These are discussed below.

### Ontario Ministry Of Labour

In Ontario, the Economic Analysis Unit of Ontario Ministry of Labour (OML) prepares estimates of the costs of compliance of proposed regulations to control worker exposure to hazardous substances in the workplace. These costs are then compared to the financial strengths of the industry, sector or firms likely to be affected by the regulation, to estimate the potential financial and economic impact in terms of profitability, employment, investment decisions, productivity and other business decisions.[1]

Compliance cost data are obtained from a number of sources. For example, estimates of incremental capital expenditures and operating costs are obtained from contractors who design and install engineering control equipment required to reduce exposure levels. Information may also be obtained from organizations in the U.S. where similar studies are undertaken. Costs of compliance are extrapolated to the industry or sector level.

Measures of financial impact used include:

- compliance capital cost as a percent of total capital expenditures on equipment; and

- Impact on ROI of operating and capital costs attributable to compliance.

As part of the regulation development process, estimates of compliance costs and economic impact, along with health effects, are taken into account in setting exposure levels. In some instances, where it can be clearly demonstrated that the financial and economic impact would be burdensome, the

---

1 Memo from Henry Turner, Strategic Policy and Analysis Unit, Policy and Regulations Branch, Ontario Ministry of Labour, April 17, 1990.

regulations may be modified, providing that the health and safety of workers are protected. As an example, a proposed regulation to control worker exposure to styrene in the reinforced plastics composite (RPC) industry was substantially modified after it was demonstrated that the financial and economic burden would have been substantial and the health risks relatively low. Boat manufacturers, who would be affected most by the proposed regulation, were judged to operate in an extremely competitive environment, and face stiff competition from manufacturers in Europe and the Northern U.S. Some Ontario boat producers were also experiencing serious financial difficulties at the time. Consequently, any substantial increase in production costs to Ontario boat manufacturers, not encountered by boat producers in other jurisdictions, would have placed the Ontario boating industry at a competitive disadvantage and, especially in a free trade environment, could have forced companies to locate south of the border. The decision was made to go with a slightly higher exposure limit for styrene in the RPC industry, but still protect the worker by requiring the use of respirators. It was also decided to review the exposure levels from time to time to ensure that workers were still being protected. In contrast, the Ontario steel industry can withstand greater cost burdens because it is technologically more advanced than the competition.

Initially, the Economic Analysis Unit attempted to develop common guidelines or criteria for conducting economic impact analyses of new regulations. However, this proved to be very difficult because of the diversity in size, employment and technological development among industries, sectors and firms. It was therefore decided to go with a flexible process. In some cases, extensive economic analyses are required due to the large number of employers and workers affected and the pervasiveness of the hazard to which workers may be exposed. In other cases, where only a few employers are affected or few workers are at risk, simpler economic studies of the industry affected are necessary for decision making.

The OML feels that it is important to prepare economic impact studies so that economic and cost impact issues are taken into account by regulators along with health factors when new regulations are developed. These studies are also used to respond to industry concerns that costs to implement regulations are burdensome and threaten their survival. In the past, the Ministry had to rely on industry studies for this information, but these sometimes tend to overstate the financial impact of proposed regulations. The Ministry does not conduct cost-benefit analysis; rather it does a financial or cost impact analysis and then looks at the overall economic consequences.

The Joint Steering Committee on Hazardous Substances in the Workplace (JSC), set up by the OML in 1987 to develop new regulations controlling worker exposure to hazardous substances in the workplace, is likely to take into consideration technological and economic feasibility in setting standards and making regulations.

### Consumer and Corporate Affairs Canada

The Department of Consumer and Corporate Affairs also does its own impact assessments of new regulations. For example, the Department estimated the costs of compliance for new workplace hazardous material regulations (WHMIS). This analysis was done for eight industry sectors, and within each sector, for four classes of firm size, for a total of 32 categories. Estimated compliance costs were compared to total value added within each category. The analysis aimed to identify those sectors which bore a disproportionate share of the costs of compliance.[1]

### Transport Canada

We spoke with two representatives of Transport Canada, about the use of the EA concept with respect to regulations in the area of hazardous materials transport, and road safety and motor vehicle regulation. If "large" impacts are identified (those greater than approximately $10 million) a detailed and quantitative financial impact analysis is carried out. This can include assessments of job loss, closure, upstream/downstream business interruptions, any secondary impacts, and municipal financial base impacts.[2]

### Labour Canada

In the Occupational Health and Safety area in Labour Canada, which deals with sectors of the economy over which the Federal government has jurisdiction, there is also some analysis of the benefits and costs of proposed regulatory initiatives. This analysis includes assessments of their allocative impacts—such as employment effects—and compliance costs.[3]

### Canadian International Trade Tribunal

We also carried our research further afield, seeking other areas in which concepts analogous to "economically achievable" were employed. The area of trade remedy law is a field in which considerable thought has been given to the assessment of negative economic impacts—i.e., "material" damages to domestic industry. The approach used in this field is described briefly below.

---

1 "Summary of the Socio-Economic Impacts of the Proposed Workplace Hazardous Materials Information System (WHMIS)", Abt Associates of Canada, March 1987; and personal communication with Ken Tiedeman, Strategic Planning, Consumer and Corporate Affairs Canada.

2 Personal communication with Marjorie Matthews, Evaluation and Analysis, Transport Dangerous Goods, Transport Canada, and with John Lawson, Traffic Safety Standards and Research, Transport Canada.

3 Personal communication with Henry Nur, Director, Legislative Development and Liason, Occupational Safety and Health Branch, Labour Canada.

For anti-dumping measures to be implemented, there must be evidence that dumping is causing "material" damages to domestic industry. In the assessment of damages attributable to dumping, three levels of severity are contemplated:

- "Serious" injury means that a company or an industry would not survive unless anti-dumping measures were implemented.

- "Material" injury is not well-defined, but has, in practice, meant that companies must definitely be suffering, or have a persistent pattern of lost profits or unemployment.

- "Immaterial" injury is judged to be acceptable. An "immaterial" injury is simply one that is not "material".

The GATT requirement that the severity of damages be at least "material" is designed to preclude the launching of obviously "spurious" actions. An "immaterial" action might be one that involves just one lost sale, or the lay-off of two people. A drop in profits of from 12 to 10 percent would probably not be considered material, while a drop of from 12 to 4 percent would be.[1]

In practice, few applications for protection are disallowed on the grounds that damages are "immaterial". Companies generally do not apply for protection until they are obviously suffering. The requirement for proof that the damages are **caused** by dumping is usually a much more significant hurdle in the application process.

The factors looked at in assessing damages are the same as those specified in the GATT anti-dumping code, and include:

- employment levels;
- market share;
- profitability;
- sales;
- excess capacity.

While legislation typically does not provide precise definitions of the criteria for determining damages based on these factors, there are well established practices, and the regulatory bodies tend to look at particular issues and have relatively consistent standards of analysis.

The resolution of issues typically occurs at hearings, in a quasi-judicial framework, with an adversary system. The analyses are subject to considerable scrutiny.

---

1 Personal communication with Réal Roy and Pat Welsh, Research, Canadian International Trade Tribunal.

The ability of the process to look carefully at a number of the issues is aided by the data gathering powers and penalties available to the Tribunal. Specific procedures have been put in place to both provide access to confidential firm and plant level data, and to ensure its confidentiality. In particular, Revenue Canada inspectors can visit suspected dumpers and verify their financial data. In addition, if companies are not willing to supply necessary financial data, the Import Tribunal can make "worst case" assumptions, to the detriment of the non-responder.

Trade remedy law differs significantly from regulatory impact assessments in that no benefit-cost analysis is contemplated in the evaluation of dumping. The focus of the analysis is to determine if imported goods are being sold below the cost of production and shipping, and if this is causing obvious damage to domestic producers. There is no need to weigh the losses of domestic producers against the potential gains by consumers, and therefore there is no explicit requirement for standards for judging allocative effects similar to those used in regulatory impact assessments.

## Conclusions

The discussion above has focused on a number of non-environmental policy areas which must also deal with the distributional effects of regulatory costs. The following observations summarize this work:

- The conceptual framework used to address EA considerations is typically similar to that used by the EPA. However, the concepts are not defined in statute or regulation, and the analytical issues are not as well delineated as those in the environmental field.

- An exception to this observation is in the area of Trade Remedy Law, where there is a clearly established practice that deals with the concept of "material damage." However, the context of this analysis is sufficiently far removed from the environmental field that we have not judged it appropriate to bring it forward.

- There is, in some cases, greater emphasis in applying the EA-type concepts retrospectively as a basis for the relief of individual firms or workplaces from regulations in place, rather than as criteria to be applied to classes of businesses in determining the appropriate level of control technology to be applied to all.

# V - Analysis of EA Concepts

## Introduction

In this chapter, we report on the final task of Phase 1—the summary and analysis of various EA concepts identified in the previous two chapters.

The Terms of Reference and initial workplan for this study were based on the premise that a number of alternative definitions of "economically achievable" have been used in environmental and non-environmental applications, particularly in the United States. The workplan was structured to collect background data on these alternative definitions, and to support the analysis of the alternatives along a number of dimensions. The analysis was to be the basis of a shortlist of alternative EA definitions, to be subjected to more intensive data-gathering and analysis in the second phase of study.

As is discussed in more detail below, the results of Phase 1 do not support this initial premise. For all practical purposes, there is only a single concept of "economically achievable" for the private sector, although it can be defined broadly or narrowly in different applications. The EA concept, as applied to categories or classes of municipalities in prospective analysis, has not been widely used. However, there are approaches which have been used by the U.S.EPA in dealing with individual municipalities, which fit within the broad EA framework, and we discuss these as well.

In those jurisdictions where the approach has been formalized sufficiently to be considered established practice, the discussion and refinement of analysis has not been at the level of defining alternative EA concepts, but rather at the level of the methods used to implement the EA definition, which have typically been various financial analysis techniques. These are also discussed below.

## Definitions Of Economic Achievability

### The Basic Definition Of Economically Achievable For The Private Sector

After a review of a number of regulatory areas in various jurisdictions, it appears that there is one prevailing measure of economic achievability, namely,

the number of plant closings and jobs lost. The greater the number of plant closings and jobs lost, the less "economically achievable" is a proposed regulation. Virtually all of the concepts of economic achievability which we identified, whether formalized or not, are based on these two indicators. Of the government bodies investigated, the U.S. EPA has made the most extensive use of these indicators. The methodologies used to implement the concept (namely, the techniques used to estimate the number of plant closings), have varied widely, however, from one application to the next, even within the EPA. Furthermore, we have identified the following additional variations with respect to the prevailing approach:

- Plant closures and job losses may be combined with additional indicators of economic achievability; they typically receive less weight and are analyzed in less detail than the two key indicators noted above. These additional indicators include price effects, foreign trade effects, competitive impacts, etc.

- Certain of these additional indicators are also sometimes used to support the plant closure/job loss analysis. In particular, analyses of the competitive position in various industries, i.e., industry market power, the role of imports, etc., are used to determine the extent to which cost increases may be passed on to customers (or perhaps passed back to suppliers), rather than having to be absorbed in the profit margins of the industry under study.

- The definition of economically achievable is often tailored to focus on small business. Typically, the impact framework is not changed, but analyses may separately identify the impact on small businesses, and may apply less stringent control requirements to them.

The prevailing EA definition is used by the U.S.EPA in applying BATEA under the Clean Water Act. It is also consistent with the approach in virtually all of the other implicit or explicit uses of the broad concept of affordability which we have identified in Chapters III and IV.

It is worth noting the relationship between this prevailing EA definition and concepts used in international trade remedy practices. The concept of "material damage," used in trade remedy law considers possible plant closures and job losses, within the context of a well developed and broader set of criteria for assessing whether harm has been caused to private sector firms. However, because its application is so different from the environmental field, and because of the unique aspects to data collection and enforcement associated with this area, we have not drawn further on this example.

The broad EA concepts are similar in the cases we have studied. In practice there is considerable variation in the actual use of formal decision criteria. In

many cases, the studies do not apply such criteria, but provide qualitative and/or quantitative analytical information to be assessed by policymakers within the context of the specific circumstances of each situation.

### The Basic Definition For Municipal Government

The concept of economically achievable has not been applied in the public sector to the same extent as in the private sector. As is discussed in Chapter III, explicit reference to economic achievability is found only in the Clean Water Act, and is used in setting effluent limitations for categories and classes of sources. To date, the EPA has only established effluent guidelines for various industrial sectors. EA assessments for the municipal sector are still being developed.

We have identified other examples in the United States where economic factors were taken into consideration in the environmental decision-making process with respect to municipal government. Typically, these measures are used on a case-by-case basis, evaluating the circumstances of specific municipalities, rather than for classes of municipalities.

The typical approach is to use a number of financial indicators, of the sort commonly used in municipal financial analysis, to determine whether the financial strength of the municipality and/or its tax base can support the relevant expenditure.

From a different perspective, U.S.EPA private sector analyses under the Clean Water Act also sometimes include a "community" impact component. This essentially considers the effects of the private sector impacts on specific individual municipalities.

### Other Entities

As a result of our analysis, we have brought forward two basic EA concepts:

- the prevailing EA concept for the private sector;
- a plausible concept for the municipal sector, based on practices for dealing with individual municipalities in the United States.

Perhaps reflecting the differences between Canada and the United States, we have not identified meaningful EA concepts that can be applied to Crown corporations and other government-owned businesses and agencies. In the remaining chapters, we will frequently discuss the applicability of the two basic concepts identified to these other entities.

The above comments are subject to the following proviso. In its report on the impact of MISA monitoring costs on the electric generation sector, the Ontario Ministry of the Environment notes that regulated monopolies can, subject to regulatory approval, pass cost increases on to their customers. Any additional costs resulting from abatement programs can be reflected in higher electricity rates.[1] The financial health of a utility will therefore not be jeopardized by abatement programs, and the use of financial ratios to predict plant closure, for example, would not be appropriate. While abatement costs are an additional burden on consumers, the impact of higher electricity rates is so dispersed that it would be difficult to identify any job losses or plant closures that might result from them.

## *Financial Impacts*

As Chapter III and Appendix A illustrate in some detail, the application of the private sector EA concepts has been primarily through the use of financial analysis. That is, the various financial analyses have been used to project the number of firm bankruptcies/plant closings and jobs lost as a result of new regulations. This analysis has been done by considering the impact of compliance costs on:

- various financial ratios, focussing particularly on solvency at the firm level;
- the "going concern" net present value of cash flows at the plant level, compared to the alternative of plant closure.

In summary, then, financial analysis techniques are used primarily to forecast or project changes in the ultimate indicators of economic achievability, i.e., plant closings and job losses. Other EA indicators are used, but these appear to be given much less weight.

In the EA definition for municipal government, there is not the same distinction between the EA concept, and the analysis techniques used to determine impacts. In a sense, the financial indicators chosen are used as direct measures of "economically achievable", so that if the addition of compliance costs pushes a financial indicator beyond some threshold, this is a direct measure of economic achievability.

---

1 Monitoring Cost Estimates and Their Implications for Direct Dischargers In the Electric Generation Sector. Ontario Ministry of the Environment, June 1989.

The terms of reference for the study require that alternative concepts of "economically achievable" be evaluated and assessed against a number of criteria. The terms of reference suggested a number of possible evaluation criteria, and additional possible criteria were identified in our proposal. One of the initial tasks of the study was to take this long list of possible criteria and concerns, to add any others which were relevant, and to narrow or distill it down to a manageable number of broader evaluation criteria. As a result of discussions with the client, the five broad evaluation criteria outlined below were identified.

As defined, these criteria were intended to apply to alternative EA concepts. In other words, on the assumption that a number of alternative concepts would be identified in the study, the application of these criteria was intended to broadly rank them. On the basis of this ranking, a small sub-set of concepts was to be carried forward into Phase 2 for more detailed analysis.

Because the number of alternative EA concepts is limited, the focus has changed. We discuss the prevailing EA concept in the context of the broad criteria. In addition, since the focus of the work in the EA area is on financial ratios, in Chapter VI we discuss the financial analysis techniques themselves.

## Evaluation Criteria

The criteria are:

- **Equity**—whether the concept treats firms "fairly," e.g., does it differentiate between the characteristics of small and large firms; does it recognize differences across industries; does it take into account distributional effects (that is, not all firms face the same cost) or geographic impacts? Perceived equity is also a factor, i.e., will the application of the criteria satisfy interested parties?

- **Applicability**—Whether the concept can be applied across industries; can it be applied to different entities (e.g., private vs. public vs. crown corporations)?

- **Comprehensiveness**—Whether the concept takes into consideration factors such as business cycles, competitive position, and ability to pass costs through.

- **Incentives**—Whether the application of the concept encourages or inhibits technological innovation or investment in new capital.

- **Administrative Requirements and Cost**—Data requirements to implement the concept, e.g., use of publicly-available information; whether analysis is required for individual plants or firms, or for an industry as a whole; whether the concept requires actual or model entities for evaluation.

## The Evaluation of the Basic EA Concepts

In the following paragraphs, we briefly discuss the prevailing EA concepts in the context of these broad criteria.

### The Private Sector Concept

#### Equity

The basic equity issue is whether the analysis treats firms "fairly." In this regard, results are mixed:

- Because of specific features which have been designed into the approach, the definition typically distinguishes between small and large firms, e.g., through the application of the Regulatory Flexibility Act in the U.S.

- The EA concept used essentially "sees through" firms, and focuses on the workers affected. Thus, there is a high degree of equitability in the treatment of workers themselves, i.e., the focus is on jobs lost, and any job lost is essentially treated equivalently.

- There is very little focus on the concept of equity of treatment of owners of capital. For example there is typically no consideration of the extent of the impairment of value of debt or equity, or any subsequent costs or impacts which are borne by equity and debt holders. In that sense, the prevailing EA concept really limits distributional considerations to workers and providers of labour, rather than providers of capital. As a consequence, the approach can treat individual owners of capital quite differently. For example, it does not distinguish between:

  - a firm which may cease production in one location, and replace it with production in another, at relatively little cost to the owners of capital, but at considerable cost to the workers in the affected location, and

- a business which may close down because the value of the assets are reduced to zero.

From a different perspective, the approach may also lead to inequitable treatment of industries. For example, effluent guidelines may be established such that the **relative** impact (in terms of plant closures and job losses) is comparable across industries. At the same time, this may result in substantial differences across industries in the **incremental** cost of pollution control imposed by the regulation. If economic achievability is measured in terms of plant closings and job losses, the focus of the analysis is on these impacts and not on the incremental cost of different levels of pollution control. As a result, industries that can "afford" to pay more for pollution control may be faced with tougher effluent guidelines than industries that cannot make similar capital and operating investments.

This circumstance can result in perverse effects, when viewed from the broader perspective of economic **efficiency** which underlies the cost benefit analysis framework. For example, it is possible that firms or industries which can "afford" to pay for pollution control are in sectors in which very high costs must be incurred to obtain marginal benefits in pollution control. If the industries that cannot "afford" to pay for pollution control are in sectors in which fairly large pollution benefits can be obtained for fairly small expenditures, then the application of the EA concept has caused society as a whole to pay a high cost to achieve marginal benefits in pollution control, even though much more substantial benefits could have been obtained at much lower cost. This creates concerns, not only about perceived equity, i.e., members of the "stronger" industry have to bear costs which others have been able to avoid, but also concerns with respect to the efficiency with which society is devoting resources to pollution control.

### Other Criteria

From the perspective of **applicability**, the basic private sector concept is attractive. Conceptually, the analysis can be applied across all industries.

The basic private sector concept of economic achievability can be made quite **comprehensive**. Although the specific application can vary, conceptually the approach can take into account factors such as business cycles, and should take into account competitive positions and considerations such as ability to pass costs through. As applied in the U.S., the methodologies may sometimes assume "worst case" views on some of these dimensions, rather than actually dealing with them directly.

The basic approach employed does not in itself appear to create strong **incentives**, e.g., to discourage or encourage technological innovation.

Instead, such incentives come into play primarily during considerations of "best available technology."

The issue of **administrative ease** relates primarily to the application of the financial indicator methodology, and this discussion is deferred until Chapter VI.

### The Municipal Concept

The municipal concept is attractive from an **equity** perspective. By its implicit focus on ability to pay considerations, it clearly takes into account different circumstances of different municipalities. In addition, because of the emphasis on the tax base as a whole, both individual taxpayers and businesses are treated similarly, and some of the concerns with respect to the equity of the private sector concept, discussed above, are not relevant.

From the perspective of **applicability** within the municipal sector, the concept is attractive. The approach used is designed for municipal governments and it can be applied in virtually all cases.

The concept appears to be sufficiently **comprehensive** to deal with a range of municipalities. There are problems with its potential applicability in Ontario, because of the specific circumstances surrounding municipal borrowing. These are discussed in some detail in Chapter VII.

The basic approach employed does not appear to have strong **incentive** impacts.

Because the analysis is structured around the availability of typical municipal financial data, **administrative ease** is a strong point of the municipal sector concept.

### Other Entities

The above discussions evaluate the two concepts under study from the perspective of their area of applicability. The prevailing private sector EA concept is both broadly applicable and quite comprehensive when considered in the context of private sector entities. However, it is not particularly applicable to the case of government-owned businesses, even if they compete with private sector firms. For example, the direction of publicly-owned businesses typically is based on some mixture of business economics and broader public policy concerns. If only private sector decision-making criteria were necessary, then presumably there is no reason for the business to be government-owned. However, broader decision-making criteria do not apply, then the use of financial analysis techniques based on private sector decision-making criteria and constraints are also not applicable to the sector. For example:

- Most government-owned businesses have some form of implicit or explicit government guarantee, so that analyses of balance sheet ratios as forecasters of possible bankruptcy are essentially irrelevant.

- For public policy reasons, plants may continue to operate even though they are "unprofitable" from a private sector perspective; thus, plant closure analyses focused on comparisons of net present values are also essentially irrelevant.

## Summary

The key results of Phase 1 are outlined below.

The original structure of the study assumed that we would carry forward from Phase 1 a shortlist of alternative EA definitions. In Phase 2, this list would be subject to more intense research and analysis, particularly with respect to information requirements and associated implementation/administration considerations, as well as the development of worked illustrative examples. Combined with the Phase 1 work, this information would be sufficient to provide the Ministry with the data and analysis required to support judgements with respect to an appropriate definition of economic achievability in Ontario.

Instead, we have found that, for all practical purposes, there are really only two definitions of economic achievability in use.

In the private sector, the concept essentially reflects a plant closure/job loss perspective, with varying degrees of emphasis on other considerations such as price impacts, foreign trade impacts, etc. It is often supplemented by a particular focus on and/or less stringent treatment of small businesses, but essentially within the same economic impact framework.

The concept is less refined in the municipal sector. In cases where it has been worked through, economic achievability is really a combination of:

- various financial measures of financial strength; and

- consideration of the geographic implications of the private sector impacts described above.

In those jurisdictions where the private sector approach has been formalized sufficiently to be considered established practice, the methodology used to implement the definitions of economic achievability described above has been the use of financial ratios and financial analysis techniques. These have been

conducted at various levels of disaggregation within an industry, and are intended to provide predictors of plant closure and employment losses.

# VI - Private Sector Financial Analysis Methodologies

## Introduction

As is noted above, the basic EA concept for the municipal sector is expressed in financial analysis terms. For the private sector, however, there is a clear distinction between the prevailing EA concept, based on various economic consequences, and the financial analysis methodologies which are used to implement the concept, i.e., to forecast job losses and plant closures.

Because of the limited number of EA concepts identified for the private sector,we have shifted the focus of the remaining workplan from alternative EA concepts, to financial analysis tools which are typically used to implement these concepts in the United States. Thus, in this chapter, we discuss two topics:

- we describe the "prototype" financial analysis methods which have evolved to support EA analyses by the U.S.EPA, and
- we consider these methodologies in the context of the evaluation criteria.

## The Basic U.S. EPA Methodology

Based on our review of a number of the U.S.EPA economic assessments, we feel that it is possible to discern a generic approach that the EPA typically follows in examining economic impacts. This approach consists of a sequence of steps, each examining impacts at a higher level of aggregation:

1. The first step consists of a plant closure analysis, typically done using a discounted cash flow approach. The present value of future cash flows after compliance is compared to current liquidation value, to determine if the owners would be better off closing the plant than conforming to abatement regulations. The EPA may also examine the change in a plant's profitability relative to the rest of the industry.

2. The plant closure and profitability tests are usually supplemented by a liquidity test, which checks whether compliance results in negative cash flow, or impairs several liquidity ratios. This analysis can be done either at the plant or the firm level, and is designed to see if a firm will have difficulty financing the abatement expenditures. All of these initial steps assume that the firm absorbs all of the costs of compliance.

3. The EPA then expresses compliance costs as a percentage of sales revenue. This can be done at the plant or firm level, to measure the impact on plant or firm profitability if there are no increases in price and firms absorb all costs of compliance. Cost absorption would be likely if the industry faces stiff competition from imports, and prices are determined in world markets.

4. Total industry compliance costs can also be compared to total industry revenue. This will provide an estimate of the average increase in industry prices, and therefore the impact on consumers, that will result from 100 percent cost-pass-through. One hundred percent cost-pass-through is likely only if the U.S. market is insulated (i.e., there are few imports), and if demand is highly inelastic.

5. The difference between the above two measures (percent compliance costs calculated at the industry level versus at the plant level) will indicate the impact on an individual plant's profitability from price increases determined by an industry's average costs of compliance. "Clean" plants may find that their profitability actually increases, if prices increase to reflect the industry's average costs of compliance. The EPA studies typically include an appraisal of market conditions (capacity utilization, import penetration, demand elasticity, and volume growth) to determine what degree of cost-pass-through is likely, and therefore which of the preceeding analyses is most likely to be relevant in forecasting actual effects.

6. The plant closures predicted in the first analytical step are aggregated across the industry to determine total employment and production capacity losses. A balance of trade impact can then be estimated by assuming that all lost production is replaced by imports. If possible, the distribution of closures is examined to see if any community or region bears undue hardship.

At each of the analytical steps above, small firms can be examined to see if they are incurring a disproportionate share of the effects.

## The Private Sector Financial Analysis Methodologies in the Context of the Evaluation Criteria

As noted in Chapter V, the criteria which were identified for evaluation of EA concepts are:

- equity
- applicability
- comprehensiveness
- incentives
- administrative requirements and cost.

The discussion below assesses the private sector financial analysis approach to determining economic achievability with respect to each of these criteria.

### Equity

There is nothing inherently **inequitable** about the use of financial measures as indicators of economic achievability. Rather, it is in the **application** of various measures that inequities can arise. We have identified three areas where inequities can occur in application—between industries, between small and large firms, and between geographic regions.

#### Industry Characteristics

Most of the financial analyses identified in our research were performed on an industry-specific basis.

The various industry-specific studies undertaken by the U.S.EPA under the Clean Water Act take different approaches. The different approaches reflect a number of factors, including the evolution of methodology, the analytical predispositions of the consultants used and of the specific EPA analysts, and the practicalities of data availability. It is clear, however, that the analyses have attempted to respond to the specifics of the particular industries studied.

Each analysis was constructed for the particular industry, and appropriate measures of affordability for each industry were chosen. For example, in the Foundry Study, a required return on assets (ROA) of 2.5% was selected because empirical evidence suggested that firms in this industry with an ROA below this level were highly susceptible to bankruptcy.

Such an industry-specific approach allows for sensitivity to the financial characteristics of each industry. For example, in another industry it may be appropriate to select a higher threshold value for return on assets in order for

this measure to distinguish effectively between bankrupt and non-bankrupt firms.

### Firm Characteristics

The analyses identified in this study take into account differences in the size of firms within an industry. The analyses were carried out using either firm-specific data for individual plants and firms within the industry, or "model" plants which were constructed to represent firms within the industry.

From the perspective of equity at the firm level, there are limitations to the model plant approach. Although considerable effort has been made by the EPA in some studies to create a number of sub-categories of model plants, reflecting differences in size, product mix, and financial health, firms are essentially being analyzed on the basis of data for the category in which they belong. Where actual firm or plant-specific data and calculations are used, this equity issue does not arise.

In addition to differentiating firms by size and/or financial status, several of the analyses examined in this study treat small firms separately. In the United States, Public Law 96-354 (the Regulatory Flexibility Act) required EPA to determine if a significant impact on a substantial number of small businesses occurs as a result of a proposed regulation. If there is a significant impact, the act requires that alternative regulatory approaches that mitigate or eliminate economic impacts on a small businesses be examined.

In some cases, the analyses do not distinguish between high-cost and low-cost operators. For example, the land disposal restrictions analysis (see Appendix A) assumes firms are severely affected if the cost of compliance increases operating costs by 5%. For firms with very high operating costs this could result in a significant impact, but for low-cost operators this increase may be absorbed easily. Thus, the use of the same threshold value for firms with different cost structures could result in an inequitable treatment of firms in terms of their "ability to pay."

### Geographic Equity

The sensitivity of the analysis to the geographic distribution of impacts depends on whether real or hypothetical data are used. In the Foundry Study, for example, model plants were used in the analysis. The results of the analysis could be used to project the number of plant closings and jobs as a result of the regulations, but could not be used to determine the localities within which those closings were likely to occur.

In contrast, in the Organic Chemicals Study, community-specific impacts were estimated.

## Applicability

One of the basic findings of our research was that the financial analysis underlying the prevailing EA concept has been applied very differently to various industries and sectors. We found limitations in terms of applicability across industries and business sectors, and as used to set standards or determine exemptions from regulations.

In the context of predicting plant closures, the appropriateness of using techniques designed to predict bankruptcy could be questioned. In practice, most plant closures probably result from voluntary decisions by management to suspend operations, rather than from outright financial insolvency. Accordingly, the EPA's use of discounted cash flow analysis is theoretically more justified, although it may be more difficult to implement.

### Across Industries

As the case studies from the United States illustrate, analyses have typically been constructed specifically for an industry or group of industries under consideration. The basic techniques employed, as distinct from the details of their implementation, are applicable across most industries. However, the experience in the United States suggests that the basic methodologies will have to be tailored on an industry-specific basis. This reflects a number of considerations:

- the financial characteristics of each industry;
- the potential burden caused by proposed regulation (for example, the pulp and paper EA analysis focused on new plants —under the "New Source Performance Standards", or NSPS— because most existing facilities could be brought into compliance at relatively low cost);[1]
- the number of firms in the industry, and the mix of small and large firms. For example, the large number of small firms in the foundry industry forced a form of "model plant" analysis, rather than attempting to collect and/or match individual firm and plant level data as has been done in other sectors;
- as the case studies indicate, it may be necessary to choose financial measures specific to the industry, and selected values for financial variables (e.g., threshold values for financial ratios)

1 "Economic Impact Analysis of Effluent Guidelines and Standards for the Pulp, Paper, and Paperboard Industry," U.S. Environmental Protection Agency, October, 1982. (Referred to in this report as the "Pulp and Paper Study.")

appropriate to the industry so that the results can differentiate meaningfully among affected and unaffected firms.

### Prospective vs. Retrospective Application

The U.S.EPA analyses which we have examined generally considered the **prospective** impacts of a proposed regulation (e.g., how an industry as a whole would be affected by the requirement). Further, where the analysis was based on model plants or firms, it would not be used to determine what would happen to a **specific** company.

Nevertheless, many of the financial ratios used in the analysis **can** be used to measure how an individual plant or firm would be affected by the regulation. (Our review of Canadian experience emphasizes this perspective.) Indeed, the economic impact analyses are merely a compilation of individual impacts (although sometimes these are represented by model firm impacts). Thus, the same analytical framework could be used to examine impacts **retrospectively.** That is, after the regulatory standards are set, a firm-specific analysis could be conducted using many of the financial measures identified here to determine if the firm would be significantly affected by the requirement, and therefore granted an extension or exemption from the regulation. This is comparable to what Ontario is currently doing when it conducts a forensic audit of a firm to determine whether the firm should be granted temporary relief from certain standards.

### Comprehensiveness

An evaluation of economic achievability cannot disregard the economic environment in which regulations are being proposed. In the United States, the financial profile of the industry is an integral part of the analysis. Financial ratios typically are used to illustrate the financial health of the industry as a whole, as well as changes in financial performance from year to year. Mean values across a number of years are then used as the baseline against which changes as a result of new regulatory requirements are compared.

The actual calculation of plant closures and job losses, however, often ignores where an industry is with respect to the business cycle at the time of the analysis. By using mean industry values from several years as the baseline, the evaluation may provide an accurate assessment of affordability over the long run. If, however, most of the costs of complying with new requirements must be borne while the industry is in an economic slump, the analysis may understate the severity of the impacts.

The U.S.EPA analyses appear to be evolving in a direction which recognizes this concern. The way in which it is addressed tends to vary by sector.

## Incentives

Comments here are essentially the same as those applied to the concepts themselves, in Chapter V.

## Administrative Ease

The administrative requirements of the EA analyses identified in this study are considerable. For the most part, the analyses are not simple applications of "rules of thumb," but entail extensive data collection and numerous calculations. Indeed, several of the U.S. analyses were conducted at a cost of over half a million dollars each. Of course, the size of these studies reflects in part the large number of firms potentially affected by the regulations. The data requirements and analytic demands of the economic achievability studies done in the U.S. are reviewed below.

### Data Requirements

The U.S. analyses are very data-intensive. Financial data are needed at the plant, firm, and industry level. Information may be obtained in one of two ways—through a survey of potentially affected plants and firms, and from public sources.

Surveys often provide the most detailed plant-specific data, depending on the information requested. In the U.S., compliance with the survey request is required under the Clean Water Act (Section 308), although firms can request that their response be treated as confidential. Surveys take time, however, and often require extensive follow-up work. In practice, the EPA has frequently not had the time to collect the detailed plant level data required to implement this approach.

Public sources of information are good for firm-specific data on publicly-owned companies. This information is fairly complete and recent, although the data may require manipulation in order to fit into the analytical framework. If an industry survey is not done, independent sources often provide the only source of information on privately held companies, who are not required to report to the Securities and Exchange Commission. Firms such as Dun & Bradstreet and Robert Morris Associates compile industry data from banks and credit reports and construct financial "profiles" for each industry. While the firm-specific data provided by these sources for private companies cannot always be verified, often the financial profiles provide an accurate picture of the industry as a whole.

In the next Chapter, we discuss the extent to which similar data sources are available in Ontario. However, it must be emphasized at this point that the data requirements required to support the ideal methodology which has evolved in the United States are extensive. Typically, for example, the EPA has been forced to make estimates of some of these data, e.g., to prorate firm level data to provide proxies for plant level information. Affected firms in the United States have argued against this approach, but do not appear to have been able to suggest a practical alternative.

### Analytic Requirements

The U.S. analyses are typically conducted at the plant, firm, and industry level (although the industry analysis is merely a compilation of plant-specific results). The OECD analyses, although not clearly defined in the literature, imply at least a firm-specific level of analysis. If actual data on affected plants are not available, and depending on the complexity of the industry, numerous model plants/firms may need to be constructed to represent the industry. The result is numerous calculations of individual plant or firm impacts (where real data are used) or of model plant impacts. The greater the number of calculations, the more sensitive the analysis will be to individual firm impacts. At the same time, this may greatly increase the resources necessary for the analysis.

## Conclusions

In a nutshell, the problem is the following. There is broad recognition that the financial analyses should be undertaken at the plant level, and that the fundamental issue is the viability of individual production units, rather than corporate "deep pockets" per se. However, in order to make such an assessment, it is necessary to understand the production cost structure of individual plants. Except in unusual circumstances, such data are not typically available in either Canada or the United States. Many of the analytical twists and turns which have been required in a number of the U.S.EPA industry studies have been in response to this deficiency. In other words, a good deal of the analytical effort has gone into attempts to infer plant level cost data, typically by some form of analogy to firm level data available from the sources noted above. While one can admire the energy and ingenuity of the analysts who have been faced with this task, one is also struck by the number of arbitrary assumptions which are required to implement these analyses, and the associated risks that the results do not correspond to reality at the detailed individual plant level.

# VII - Applicability To Ontario

## Introduction

Chapters III through VI have focused on:

- identifying and critiquing various applications of the EA concept;
- discussing the financial analysis tools which are used to forecast whether various abatement levels are "economically achievable".

This distinction between EA measures and tools for forecasting them, applies only in the private sector. The municipal sector concept essentially uses financial indicators as the ultimate EA measures.

This chapter considers the applicability of these results to the Ontario situation. Since the issues are somewhat different, it deals separately with the private sector and municipal sector perspectives.

Although we do not have clearly defined EA concepts for other entities, we discuss some of the issues related to the broader use of EA for these entities, in the Ontario context.

## The Private Sector Perspective

When considering the applicability of the Phase 1 results to the Ontario situation, two types of concerns can arise:

- Are the prevailing EA concepts, which are used in the United States, applicable in the Ontario situation?
- If so, are the various forecasting tools (typically financial analysis techniques) used in the United States applicable to the Ontario situation.

These concerns are described in greater detail below.

## Applicability Of The Concept

The basic EA concept used by the EPA, as applied to the private sector, appears to be broadly applicable in Ontario. This is true for the following reasons:

- Although the concepts are sometimes less well delineated in Canada, the basic approach, i.e., focusing on plant closures and job losses, with varying degrees of attention placed on other indicators, appears to be broadly used in Canada.

- The work done by the Ontario Ministry of Environment to evaluate monitoring costs associated with the MISA program uses the criteria of employment impacts as fundamental measures of economic achievability. These employment impact assessments are based on financial analysis tools which are broadly similar to those used by the EPA. In addition, this work includes other financial analyses, which may in fact give a more balanced treatment of impacts on labour and capital than is implicit in the U.S. EPA structure.

## Issues Related To The Forecasting Tools

In the following paragraphs, we discuss the applicability to Ontario of the forecasting tools used in the United States. To place these concerns in context, it is worthwhile to reiterate the basic toolkit towards which U.S. EPA studies appear to be evolving, i.e.:

- the use of financial ratios to assess firm level issues of viability; and

- the use of various discounted cash flow analysis techniques, typically to synthesized plant level data, to estimate plant closures.

These two approaches raise a number of issues, which vary in importance depending on the emphasis placed on the ratio approach versus the plant closure approach. For reasons which are discussed in more detail below, it may be necessary in Ontario to place a relatively greater emphasis on firm level data, and consequently on financial ratios, than is necessary in the United States. This reflects potential difficulties in obtaining appropriate plant level cost data, even in proxy form, and consequent limitations on the ability to address EA at the plant level.

## Empirical Basis Of Financial Ratios

One factor which has apparently led the U.S. EPA to use their financial ratios approach is what is, in their view, a strong empirical linkage between various financial ratios, and actual or likely financial failure of individual firms. This empirical linkage has reportedly been established in the academic literature in the U.S.[1]

When considering the transferability of results, this raises the question as to whether there is a similar empirical literature on the linkage between financial indicators and financial failure in Canada. We found two Canadian articles that proposed multivariate functions to discriminate between failing and non-failing firms.[2] These functions are quite similar to those found by recent researchers in the field in the U.S. (See Appendix B.) The Canadian studies, however, do not provide any direct insight into the applicability of the EPA's single ratio approach to the Canadian environment.[3]

This is not to suggest that the U.S. findings are irrelevant in the Ontario situation. However, as is discussed below, there may be substantial differences between the two jurisdictions. It is possible that both:

- Financial ratios are not good forecasters of financial difficulty in Canada (although this seems unlikely on intuitive grounds); and
- The appropriate indicators or thresholds in Ontario may be quite different than those in the United States. This is of greater concern and is discussed below.

## Appropriateness Of Thresholds And Parameters

Assuming that financial indicators are also good predictors of economic achievability in Ontario there is still the question of appropriate thresholds or ways of implementing these indicators. While the private sector financial structure in Canada is broadly similar to that in the U.S., there are some factors which may make it appropriate to have different threshold levels of specific indicators. These include the following:

---

1 Foundry Study, U.S. EPA

2 E. Sands, G. Springate and T. Var, "Predicting Business Failures." CGA Magazine, May 1983. E. Altman and M. Lavallee, "Un modèle discriminant de prédiction des faillites au Canada", Finance, Vol. 1, Part 1, 1980.

3 In the Foundry Study, the EPA examined financial ratios one at a time, and counted up the number of ratios that "failed" their individual thresholds to get an overall plant score. Multivariate analysis combines a number of ratios into a single linear equation. The output of this equation is then compared to a benchmark.

- **Differences in ownership structure.** A good deal of Ontario manufacturing operates as branch plants owned either in the U.S. or elsewhere. In many cases, the financial structure of the companies may be influenced by, e.g., tax considerations, with a recognition that the ultimate financial strength of the parent lies in the background in one form or another. Thus, for example, a subsidiary may be structured with relatively small amount of equity and high levels of debt. However, this has been a choice of the parent, and is not necessarily an indicator of financial weakness, per se.

- **Differences in lender views.** Canadian lending institutions may have different attitudes with respect to appropriate levels of debt than many lenders in the U.S. While capital markets are somewhat North American in scope, lenders have different requirements for solvency, and thus different indicators of financial viability. This is influenced by, among other factors, two consideration:

  - much greater acceptance of junk bond financing in the U.S., with associated very high debt levels and high yielding low quality debt, which requires substantial cash flows for debt service;

  - the existence of "Chapter 11" business failure provisions in the U.S., which provide a transition period for business restructuring, as opposed to the "seize and sell" approach to liquidation in Ontario.

While these considerations do not guarantee that the appropriate threshold levels of financial indicators differ in the two jurisdictions, they certainly raise the issue as to whether such differences exist. In the absence of any literature on this subject, this is a possible impediment to implementation.

The same considerations also apply to a number of the parameters used in the United States with respect to the discounted cash flow analysis underlying plant closure studies. Typically, such analysis has been structured around a number of assumptions or key parameters, e.g., salvage value of fixed assets as a percentage of book value. In reviewing the U.S. literature, we have not identified the same "pedigree" associated with these assumptions, as underlay the choice of various financial ratio thresholds in the foundry study. Thus, it is more difficult to determine whether these parameter values can be imported from the U.S. analysis, and, if not, whether there is a literature in Canada which supports the choice of parameter values.

As is discussed in greater detail in a subsequent chapter, differences in the tax treatment of pollution control expenditures in the two countries require that the U.S. approach, on both plant and firm levels, be restructured somewhat to be applicable in Ontario.

### Industrial Structure

The methodologies used by the U.S. EPA in the conduct of their financial analyses reflect the size and diversity of the industrial structure in the U.S. This creates both strengths and weaknesses in the U.S. approach. For example:

- There are so many participants in some industries that it is virtually impossible to collect high quality financial data on all of them. At the extreme, the "forensic audit" approach to data quality is prohibitively expensive. In some studies which we have reviewed, this has led to various explicit or implicit "model firm" or "model plant" approaches.

- Because there are so many industry participants, reasonably large inaccuracies can be tolerated in individual plant or company financial data, as long as financial data are unbiased. In other words, one relies on the concept of offsetting errors and the statistical properties of the analysis to provide comfort regarding the reliability of the results.

Two issues are relevant when considering the applicability of the approach in Ontario:

- In many industry sectors, there are so few firms that individual industry participants are quite identifiable. Consequently, if plant closure or business failure is predicted, typically a specific, identifiable firm is judged to be in danger. This puts greater onus on the analysts to ensure that data quality is acceptable. In particular, it makes it difficult to use the "model firm approach," as has been done in the United States when actual firm level data was not available. It is difficult to justify model firm analysis in many of Ontario's major polluting industries, in which there are only a handful of large participants, each with its own idiosyncrasies.

- While the data must be collected from fewer firms, there are not necessarily fewer firms in proportion to the size of the economy. Thus the costs of high quality data collection may still appear to be prohibitive.

### Quality Of Data At The Firm Level

In many circumstances, the quality of publicly-available data, on a company basis, may be poorer in Ontario than in the United States. This reflects several circumstances:

- There is a higher percentage of subsidiaries and other private companies in Canada than in the U.S.

- For public companies, the U.S. SEC reporting requirements are more stringent than those in any other jurisdictions, so that more corporate financial and line of business data are available for many public U.S. firms than for comparable Canadian firms.

- Many industry sectors in the United States are sufficiently large that consulting firms of various sorts become specialists in a sector. Special multi-client studies, which may involve a pooling of industry data, are typically found much more frequently in the United States than in Canada. They provide adultional publicly-available benchmark data which can be used by analysts to support and validate the firm and plant level analysis.

These factors seem to suggest that, to obtain similar levels of credibility, it may be necessary to invest proportionately more in data gathering in Ontario than in the United States.

### The Problem Of Plant Level Data

The conduct of EA assessments by the U.S. EPA with respect to the private sector has evolved over the years, as the Agency has developed more experience with the technique, and as the early applications of the technique have been critiqued by various interested parties. Although it may not be explicitly stated, the underlying rationale for the approach appears to be as follows:

- Rational private sector companies make decisions with respect to the viability of individual production facilities, or, in some cases, individual products or product lines within production facilities. These may be "make or buy" decisions, i.e., can they pay someone else to provide a product more cheaply; or sourcing decisions among existing or perhaps proposed new facilities which they own. For that reason, the appropriate focus of analysis is individual facility plant closures and job losses. It is this perspective which has led to the growing use of discounted cash flow techniques attempting to assess the viability of individual plants in the face of pollution control expenditures.

- However, data are much more readily available, and of a better quality, at the corporate or firm level than at the plant level. This has led the U.S.EPA to the development of a number of analytical approaches, customized to individual industry sectors, which attempt to somehow model or proxy plant level production economics, with the use of corporate financial statements. The extent to which these linkages are plausible depends on the extent to which one can identify a sub-segment of the corporate level income statements, so that one has some confidence that these data parallel the economics of individual plants. From this perspective, the ideal firm level data are for single plant, single business entities, while data from large, diverse companies are inappropriate for this purpose.

- The third thread in the analysis is the recognition that competitive factors in an industry have a significant impact on whether the industry members as a whole are likely to be able to:

  - pass along cost increases to customers (or shift them back to suppliers), presumably blunting their impact in the process, or whether

  - cost increases due to pollution abatement expenditures will essentially flow through to the income statements of the firms in the industry being examined.

The whole approach, as discussed above, is based on the assumption that:

- companies regard plant level data as proprietary information, and will object strenuously if they are forced to disclose it; and

- it is extremely expensive to obtain and validate such data, even if companies are willing to provide it.

In this context, it is interesting to note that the U.S. EPA has developed a questionnaire which is intended to obtain extensive levels of plant level data. Typically, however, the EPA has been unable to obtain all the information desired, and has had to approximate it through other means.

All of these considerations are of relevance to Ontario. In particular, there are a number of reasons why it is even more difficult to establish any linkages between firm level data and plant level data in Ontario, than in the U.S. These include the following:

- **The higher percentage of foreign subsidiaries in Canada.** In comparison with a standalone public company,

balance sheet and income statement data, even if available, are more likely to reflect internal corporate considerations with respect to transfer pricing, tax issues, etc., than fundamental plant level economics.

- **The effect of the smaller size of the Canadian economy.** There are relatively few public single industry (and particularly single plant) companies in the sectors of interest to MISA.

- **The relatively limited number of players in individual sectors.** For credibility, analysis in Ontario requires a clear mapping between specific firm level financial data and associated plants owned by that firm, rather than the more general or anonymous methodologies which have been used in some of the large U.S. industry sectors, i.e., mapping typical firm data against typical plant data.

## Implications

This brief review of some of the factors related to the applicability of Phase 1 results to the Ontario situation raises some concerns, not all of which may be fully addressed in the current study. These include:

- To date, we have not identified any "made in Canada" empirical support for the forecasting methodology used in the United States, although on intuitive grounds, the basic methodology seems to make sense.

- More importantly, there do not appear to be studies which identify the appropriate thresholds which can be used as indicators of severe economic harm at the individual plant or firm level. There are arguments for thinking that different threshold levels for some indicators may apply, but we have not identified any empirical basis for this judgement.

- The industrial structure of the United States promotes the use of "model firm" and statistically-based analyses, which may be more difficult to apply in Ontario.

- The available information on the financial structure of firms in Canada, if used to proxy plant level economics for which data are not directly available, is likely to be less credible in Ontario than in the United States.

In our view, these concerns, and particularly the latter two concerns, are substantive, and place real constraints on the ability of the Ministry to directly transfer some of the detailed approaches used in the United States.

## Municipal Sector

As Chapter III describes, the U.S.EPA has not undertaken the types of detailed EA studies in the U.S. municipal sector, as has been done for a number of industry sectors under the Clean Water Act. Instead, we have identified approaches which have been used on a case-by-case basis in the United States, and have used these as a "proxy" for an EA approach to the municipal sector as a whole.

In summary, the approach used in the United States considers three components:

- various financial measures to assess local financial conditions (and particularly the impact of individual projects on these conditions);
- measures for determining the annual costs per household of proposed facilities;
- methods for assessing community impacts resulting from plant closures or reduced production levels. (This component is essentially just a geographic disaggregation of the private sector impact analysis. Conceptually, such an analysis could have feedback to the prior two measures. For example, a major plant closure can affect the assessment base and tax revenues available to a municipality, thus both affecting the financial strength of the municipality, and shifting costs from that industry to households. However, this feedback is only relevant in the case of very large closures in relation to municipal size, and does not appear to have been considered in the United States.)

The focus of the following paragraphs is on the first two of these three topics.

In the following paragraphs, we discuss the first two components in greater detail, and particularly their applicability in the Ontario situation. First, however, we provide some background on the role of municipalities in Ontario, and particularly, on how they are restricted in their borrowing.

## Municipalities in Ontario

Ontario municipalities are legally creatures of the provincial government, whose legislation both creates them and establishes the environment in which they operate. One area of municipal operations which is closely monitored and controlled by the province is municipal finance. In particular, the Ontario Municipal Board, a creation of the provincial government, must approve all municipal borrowing, and also imposes tight constraints on the types of expenditures for which debt may be raised.

Apart from short-term requirements, operating expenditures cannot be financed through debt. Capital expenditures can be financed through a combination of long-term debt, current taxes, and the use of various reserves and reserve funds, particularly "developer levies." The OMB has debt capacity guidelines that limit the proportion of debt service expenditures to 20% of total "own-purpose" tax revenues[1]. These limits, when applied to individual municipalities, limit the total amount of outstanding debt, as a function of the size, property tax base, and municipal financial conditions of the municipality. While these limits are applied with discretion, any municipality exceeding the limits is generally expected to come on side very quickly.

In fact, most municipalities in Ontario have maintained their borrowing at levels considerably below the constraints which would be imposed by the Ontario Municipal Board. Out of approximately 1400 applications for borrowing made annually by Ontario municipalities, only about 30 to 40 involve the OMB guidelines being exceeded. For most municipalities, debt service expenditures account for no more than 6% to 8% of their budget.[2]

Although municipal defaults on debt instruments occurred in the 1930s, Ontario municipal debt has been quite sound since that time, and Ontario municipalities essentially do not "go broke" as a result of overexpansion or fiscally imprudent levels of capital expenditures. Where municipal financial difficulties do arise, they are typically in resource-based municipalities which lose a major employer and taxpayer, e.g., a mill closure.

## U.S. Measures Of Municipal Financial Conditions

The measures of municipal financial conditions cited in the Chapter III are typical of the measures which have traditionally been used to assess the sound-

---

1 Personal communication from Carolyn, Manager, Planning and Municipal Finance, Ontario Municipal Board.
"Own-purpose" tax revenues exclude funds collected on behalf of local school boards or regional governments.

2 Personal communication from Carolyn Fenn, Ontario Municipal Board.

ness of municipal bonds. In other words, municipal bond analysts have applied such financial ratios to determine the degree of financial risk associated with individual municipal debt instruments, and have in effect determined their interest rate requirements for those securities accordingly.

The Canadian Securities Course, prepared by the Investment Dealers Association of Canada, is a pre-requisite to becoming a licenced stockbroker in Ontario[1]. It has typically included as one item in its curriculum, a module on municipal debt evaluation with criteria similar to that used by bond analysts. Exhibit VII-1, summarizes the factors considered. However, in part because of the reasons noted above, this component has received reduced emphasis in recent years.

### Relevance To Ontario

In practice, the addition of environmental expenditures will not in themselves cause Ontario municipalities to exceed the debt limits imposed by the OMB. In cases in which the limits are being approached and enforced, the impact of additional environmental expenditures is not to cause deteriorating municipal financial conditions, but rather to force the municipality to allocate or "ration" its available debt capacity against the various capital expenditures which might be undertaken (or increase capital spending from current revenues, which does not affect debt levels). From this perspective, the concept of "economically achievable" or "affordability" in Ontario is perhaps better related to an understanding of the nature and importance of the foregone capital expenditures due to environmental expenditures, than to a focus on measures of financial conditions per se. This clearly creates a potential concern for the study, because of the difficulty of obtaining objective data on both:

- exactly which capital expenditures are foregone; and
- the importance of these expenditures.

In cases in which borrowing limits are not being approached, presumably the municipality can finance the additional capital expenditures without putting itself in a position with which the Ontario Municipal Board would feel uncomfortable, i.e., total borrowing would be maintained at a level which maintains the fiscal integrity of the municipality. If this is the case, those financial indicators used in the United States which are intended to measure "fiscal integrity" are probably irrelevant.

---

1 "The Canadian Securities Course." Investment Dealers Association of Canada, 1987.

EXHIBIT VII-1

CRITERIA FOR EVALUATING MUNICIPAL DEBENTURES
CANADIAN SECURITIES COURSE

1. **Trend of Population**

A slow but steady increase is the most desirable. Population decline places burden on the remaining taxpayers, while too rapid an increase necessitates the rapid expansion of infrastructure, which can result in a large increase in the debt burden.

2. **Assessed Value of Taxable Property**

Assessments should be uniform, and a balanced distribution among the residential, commercial, and industrial sectors lends a degree of stability. It is considered desirable if 40% or more of the assessment is for industrial and/or commercial properties.

3. **Relation of Debt Charges to Total Revenue**

Actual and estimated future debt charges should not exceed 10% to 15% of projected revenues.

4. **Tax Rate**

The rate must be high enough to provide the necessary services, but not too high to discourage new residences and businesses from moving in. The tax levy per capita can be a useful measure in evaluating the combined effect of the mill rate and property assessments.

5. **Tax Collections**

Collections of the current year's levy, together with the tax arrears outstanding from prior years, should at least equal the current levy. "Tax arrears per capita" and "percentage of current tax collections to levy" are two sensitive indices of a community's ability to carry its tax load.

6. **Industry**

Widely diversified industry is desirable due to the greater steadiness of employment provided. If one industry closes down, the overall effect on the community is usually not serious.

7. **Recurring Bank Loans**

These are undesirable and usually reflect poor tax collections or unwise spending on capital account.

## U.S. Measures Of Annual Costs Per Household

Broadly similar comments also apply when considering the relevance of U.S. measures of annual costs per household of proposed facilities. In other words, to the extent that OMB borrowing limits come into force, these expenditures will not in fact be made, and impacts on households will not be felt. Given the presence of borrowing restrictions, and a need for the expenditures, municipalities may choose to finance these expenditures from current revenues, so that the cost will flow through directly into current taxes. To this extent, the U.S. measures remain conceptually relevant.

If the municipalities are currently below their borrowing limits, the addition of environmental expenditure costs will flow through to per household measures, which remain conceptually relevant.

## Appropriate Thresholds And Cutoffs In The Ontario Situation

To the extent that the U.S. measures discussed above are conceptually appropriate in Ontario, there is still the question of whether the cutoffs and thresholds identified in the U.S. studies are of relevance in Ontario. Because of the different relative importance of municipal taxation, as well as different levels of support to municipalities from higher levels of government, it is possible that the U.S. thresholds are inappropriate in Canada.

## Implications Of The EA Concept For Municipalities

We have explored the EA concept for municipalities defined in Chapter V. There are two relevant aspects of this approach:

- to provide a broad assessment of local financial conditions, using a perspective typically used by lenders to municipalities; and

- to determine the annual cost per household of proposed facilities.

The conceptual relevance of these measures to Ontario is reduced by the existence of strict provincial limits on the extent of municipal indebtedness. For municipalities near these limits, additional environmental capital expenditures may force other expenditures "off the table," rather than cause a deterioration of local financial conditions. If nothing is pushed off the table, the implication is that either:

- more capital expenditure will be financed from current taxes, which may not affect municipal financial conditions, but will flow through to the "cost per household" measures, used in the United States; or

- the municipal financial condition is sufficiently sound that additional debt service requirements will not impair the financial integrity of the municipality, so that the relevance of measures seeking to assess this impairment are not relevant.

# VIII - Worked Examples

## Introduction

In this chapter, we provide some "worked examples", i.e., we illustrate the application of certain aspects of the EPA approach, in the context of data likely to be available in Ontario. In addition, we provide some comments with respect to data availability and data requirements. Three examples are provided:

- an example of private sector financial ratio analysis, based on available data from Dun and Bradstreet[1] (Exhibit VIII-1);
- a similar analysis, based on an alternative source of industry data, the CCH Financial Survey of Canadian Business Performance[2] (Exhibit VIII-2); and
- the application of some of the municipal financial guidelines provided in Chapter III, in the context of actual use of municipal financial data for a representative Ontario municipality (Sarnia) (Exhibit VIII-3).

Before providing these worked samples, we first review some of the study findings, which bear on the relevance and usefulness of the worked examples in general.

## Recap Of Study Findings

The Terms of Reference for the study anticipated that a major output of the work would be a set of "worked examples", which would essentially illustrate, in some detail, the most appropriate definitions of the concept of "economically achievable" resulting from the analysis. As the study has evolved, the focus has shifted somewhat from definitions of EA per se, to various financial analysis techniques used to forecast changes in indicators of economic achievability. In addition, while one can take the view that a common methodological

1 "Industry Norms and Key Business Ratios," Dun & Bradstreet Canada, 1987. (Referred to in this report as the "Dun & Bradstreet" data.)

2 "Financial Survey of Canadian Business Performance, 1989 Edition," CCH Canada Limited, and Supply and Services Canada, November 1989. (Referred to in this report as the "CCH Financial Survey.")

framework has evolved in the EPA's application of financial analysis techniques to the issue of EA, much of the detailed analysis and data manipulation in individual economic impact statements prepared by the EPA within the BAT EA context has been very sector-specific. In other words, the EPA has taken available data on the industry, which is typically not ideally suited for the purpose, and structured it into the analytical framework desired. Differences among industries in the number and size of industry participants, as well as ownership status, has led to some ingenious analytical approaches to attempt to achieve the objectives of the specific studies.

However, this state of affairs limits the usefulness of attempting to illustrate similar approaches in the Ontario context. This is true for two basic reasons:

- the details of the individual approach with respect to each industry study by the EPA are specific to the circumstances surrounding that industry, as described above, and
- as we have argued in Chapter VII, there are a number of factors which reduce the applicability of these specific EPA projects to the Ontario situation.

These issues have been reviewed with the Ministry and it has been agreed that the focus of the "worked examples" should be on:

- a discussion of various steps in the analysis, and related data availability issues, and
- some illustrative calculations of components of the overall EPA approach, translated into the Ontario context where these appear to be appropriate.

The other factor which has limited the scope of the approach to illustrative calculations is discussed below.

The Terms of Reference for the study envisage that alternative EA definitions, with associated worked examples, be provided not only for private sector corporations and for municipalities, but for a wide range of other government agencies and operations. While the basic definitions of EA may be equally applicable to such entities, there is considerable doubt as to the appropriateness of financial analysis tools as the basis for estimating changes in EA indicators, and particularly those tools which we have identified for the private sector and for municipalities. Essentially, no financial analysis techniques applicable to these other government sectors and entities have been identified, and consequently no worked examples are provided.

## Private-Sector Corporations

Two examples are provided of the use of financial ratios to assess the economic impact of abatement costs on private sector corporations. The same ratios, and corresponding threshold values, as were found in the Foundry Study were used to assess financial health (see Appendix A). The first example uses data available from Dun & Bradstreet. The second uses data taken from the CCH Financial Survey of Canadian Business Performance. The same industry, iron foundries, was used for both examples to help highlight the differences between the two data sources.

## Differences Between Data Sources

In reporting financial statement data within an industry and size classification, the CCH Survey simply totals the values reported by individual companies. The Financial Statements of a hypothetical 'average' firm can therefore be derived by dividing CCH's published values by the number of companies surveyed.

The financial statements reported by Dun & Bradstreet provide much less detail than the CCH financial survey, particularly with respect to income statement items. Both sources report industry financial ratios, but the derivation of these ratios is different. CCH calculates ratios from the aggregate financial statements that it presents, and thus each CCH ratio represents a weighted 'average' of all firms taken together. For each ratio, in contrast, Dun & Bradstreet reports the median, and upper and lower quartile values, taken directly from the population of individual firm ratios.

Furthermore, the size categories used by CCH do not correspond to the size categories used by Dun & Bradstreet. Combined with differences between the two services in the sample of firms used, this means that the data reported for any given industry, in general, will be different.

Differences in the data offered by the two sources means that different approaches have to be used to calculate the impact of compliance on firm financial health. These different approaches are illustrated in the worked examples.

## Data Limitations

The data reported in both Dun & Bradstreet and the CCH Financial Survey reflect the aggregated financial statements of a sample of Canadian firms within a given industry. The first limitation of these data is that they include firms in provinces other than Ontario. The second is that each firm is classified to a single SIC code, which is based, in general, on the activity that contributes the largest share of value-added. The financial statements reported for an industry will therefore reflect all activities undertaken by member firms, including those that would more-properly be classified in other industries. Furthermore, the Dun & Bradstreet and CCH data are firm-level. We have to assume, as the EPA often has, that firm-level data can act as a proxy for plant-level data.

## Methodology And Assumptions

The worked examples show the preparation of financial statements for a "model" firm, and then the modification of these statements to reflect the additional capital and operating costs imposed by compliance with assume abatement regulations. For the modified financial statements, we then calculated the values of those ratios used by the EPA's Foundry Study to indicate financial health.

In calculating the effect of capital expenditures on a firm's financial health, consideration has to be given to the issue of deferred taxes. Deferred taxes are a non-cash expense that arise from differences between the capital cost allowance (CCA) allowed for tax purposes, and the depreciation claimed for book purposes. Deferred taxes are declared to offset the cash-flow benefit that results from an accelerated write-off of equipment for tax purposes. They are used to equalize reported net income (book) over the life of depreciable equipment. While deferred taxes do not impact cash flow, they do lower the reported net income in the initial years following equipment purchase. They therefore lower the value of Return on Assets, which is one of the financial ratios chosen by the EPA.

Both worked examples incorporate the following assumptions:

1. The capital costs per firm for abatement control equipment are $360,000. This cost is financed through debt at an interest rate of 11 percent per annum and a term of 10 years, with no principal repayments required until the end of term.

2. The expected life of the control equipment is 10 years, and depreciation for book purposes is straight-line over this period.

3. For tax purposes, the equipment is written-off over three years.

4. Annual operating costs of the abatement equipment are $45,000.

5. The corporate income tax rate is 46 percent.

## *Example 1*

This worked example duplicates the approach taken by the EPA to derive hypothetical financial statements for a series of "model" plants, to modify these statements to reflect projected abatement costs, and then test for closure using financial ratio tests.

For the foundry industry, the EPA first calculated the average sales level of actual plants within a size category, and then set the sales of the corresponding "model" plants to that value. Starting from this level of plant sales, the EPA worked "backwards" to derive values of the income statement and balance sheet items that would be needed to apply the ratio tests of financial health.

### Ratio Tests

As discussed in Chapter III, the EPA used three ratios as predictors of bankruptcy. These ratios, and the balance sheet and income statement items required to calculate them, are listed below:

| Ratios | Required Inputs |
|---|---|
| 1. Return on assets; | Net Income After Tax, Total Assets |
| 2. Cash flow to total debt; | Cash flow, Total Debt |
| 3. Total debt to total assets. | Total Debt, Total Assets |

To derive the income and balance sheet items that it needed to apply these ratio tests, the EPA relied on four additional ratios whose values were available from Dun & Bradstreet:

1. Return on sales;
2. Sales to net worth;
3. Debt to net worth;
4. Net fixed assets to net worth.

Dun & Bradstreet calculates median, and upper and lower quartile values of these ratios for various size classes of firms (according to level of assets), and by industrial sector.

## EPA Methodology And Assumptions

Before applying the Dun & Bradstreet ratios, the EPA grouped the upper quartile value of return on sales with the lower quartile values of the three other ratios. Similarly, it grouped the lower quartile value of return on sales with the upper quartile values of the remaining ratios. Each of the median ratios were grouped together. This created three sets of ratios, and each set was assumed to correspond to a model plant of different financial health.

In grouping the ratios, the EPA followed the rationale that an increasing ratio of debt to equity imposes interest costs that reduce the return on sales of a plant. A more leveraged plant should also show a higher ratio of sales to net worth, and of net fixed assets to net worth.

It should be noted that the EPA's method of grouping ratios, while plausible, is arbitrary. As discussed in further detail in Appendix A, Dun & Bradstreet finds quartile values for each financial ratio individually. The lower quartile value of debt to net worth is taken from the firm whose value for that ratio is lower than that found in 75 percent of the firms in the sector, and higher than that found in the remaining 25 percent. The firm that provides the lower quartile value for debt to net worth will not, in general, be the firm providing the lower quartile value of the sales to net worth. In effect, the EPA's approach groups ratios from different firms, and constructs a hypothetical model plant. To the extent that financial ratios have unusual distributions in the population of sampled firms, the "model" plants constructed may have implausible financial characteristics.

With each group of Dun & Bradstreet ratios, the EPA calculated income and balance sheet items for a "model" plant, using plant sales as a starting point. This process is duplicated in Exhibit VIII-1b, using the Canadian data listed in Exhibit VIII-1a. The right-hand column of Exhibit VIII-1b lists the sources of the values listed, or the formulas used to calculate them. Exhibit VIII-1b duplicates the procedures found in Exhibit A-2 of Appendix A, in which a sample of EPA calculations is provided.

## Adjustments For Canadian Data Sources

Values for one ratio, sales to net worth, are not published by Dun & Bradstreet Canada. To allow us to illustrate the EPA methodology in our worked example, we calculated a mean value for the ratio of sales to net worth from the average balance sheet data present by Dun & Bradstreet for Canadian firms. This gave us only one (mean) value for this ratio, rather than upper, lower and median quartile values, so that the resulting variability between the calculated "model" plants is not as great as it otherwise would be.

**Exhibit VIII-1a**

# DUN & BRADSTREET WORKED EXAMPLE

## ASSUMED PROJECT COSTS

| | | |
|---|---|---|
| A. | Capital Cost Per Plant | $360,000 |
| B. | Interest Rate | 11.00% |
| C. | Useful life | 10 years |
| D. | Income Tax Rates | 46.00% |
| E. | Annual Operating Expense | $45,000 |

## DUN & BRADSTREET DATA

SIC 3320: Canadian Iron and Steel Foundries, Assets > $1,000,000, 1987

### 1. FINANCIAL RATIOS REPORTED BY DUN & BRADSTREET

| | Upper Quartile [1] | Median [1] | Lower Quartile [1] |
|---|---|---|---|
| Return On Sales | 5.3% | 2.4% | 0.6% |
| Sales to Net Worth (Mean value) | | 4.37 | |
| Debt to Net Worth | 263.1% | 152.7% | 61.1% |
| Net Fixed Assets to Net Worth | 197.5% | 80.8% | 49.7% |

### 2i) ALLOCATION OF DUN & BRADSTREET RATIOS TO THE THREE EPA MODEL PLANTS

| Model Plant | Upper Quartile Plant [2] | Median Plant [2] | Lower Quartile Plant [2] |
|---|---|---|---|
| Return On Sales | Upper | Median | Lower |
| Sales to Net Worth | Lower | Median | Upper |
| Debt to Net Worth | Lower | Median | Upper |
| Net Fixed Assets to Net Worth | Lower | Median | Upper |

### 2ii) RESULTANT GROUPING OF RATIOS FOR CREATION OF FINANCIAL STATEMENTS

| Model Plant | Upper Quartile Plant [2] | Median Plant [2] | Lower Quartile Plant [2] |
|---|---|---|---|
| Return On Sales | 5.3% | 2.4% | 0.6% |
| Sales to Net Worth | | 4.37 | |
| Debt to Net Worth | 61.1% | 152.7% | 263.1% |
| Net Fixed Assets to Net Worth | 49.7% | 80.8% | 1967.5% |

**Notes:**

1. These quartile rankings are based on the numerical values of the reported ratios, rather than on assumed desirability.
2. These quartile rankings reflect the financial health of the model plant. For example, the "Upper Quartile" plant, which is constructed to be the most profitable of the three model plants, is assumed to have the lowest ratio of debt to net worth.

Exhibit VIII-1b

## DUN & BRADSTREET WORKED EXAMPLE

## PRE-COMPLIANCE FINANCIAL STATEMENTS
($ thousands)

| Line Item | | Upper Quartile Plant | Median Plant | Lower Quartile Plant | REFERENCE |
|---|---|---|---|---|---|
| 1. | Sales | 3,985 | 3,985 | 3,985 | From CCH data |
| 2. | Return On Sales (4) | 5.3% | 2.4% | 0.6% | From Dun & Bradstreet |
| 3. | Sales to Net Worth (4) | | 4.37 | | From Dun & Bradstreet |
| 4. | Debt to Net Worth (4) | 61.1% | 152.7% | 263.1% | From Dun & Bradstreet |
| 5. | Net Fixed Assets to Net Worth (4) | 49.7% | 80.8% | 197.5% | From Dun & Bradstreet |
| 6. | | | | | See Note (3) |
| 7. | Depreciation to Net Fixed Assets | 15.8% | 15.8% | 15.8% | From CCH ratios |
| 8. | Net Income | 211.2 | 95.6 | 23.9 | (1) x (2) |
| 9. | Net Worth | 1,431.6 | 912.7 | 635.2 | (1) / (3), For Median Only (2) |
| 10. | Debt | 874.7 | 1,393.6 | 1,671.1 | (4) x (9), For Median Only (2) |
| 11. | Total Assets | 2,306.3 | 2,306.3 | 2,306.3 | (9) + (10), For Median Only (2) |
| 12. | Net Fixed Assets | 711.5 | 737.4 | 1,254.5 | (5) x (9) |
| 13. | | | | | See Note (3) |
| 14. | Depreciation | 112.5 | 116.6 | 198.3 | (7) x (12) |
| 15. | Cash Flow | 323.7 | 212.2 | 222.2 | (8) + (14) |
| 16. | Return on Assets | 9.2% | 4.1% | 1.0% | (8) / (11) |
| 17. | Debt/Assets | 37.9% | 60.4% | 72.5% | (10) / (11) |
| 18. | Cash Flow To Debt | 37.0% | 15.2% | 13.3% | (15) / (10) |
| 19. | Net Income Before Taxes | 391.1 | 177.1 | 44.3 | (8) / (1 - 46%) |

Notes

(1) This Exhibit is based on Exhibit A-2 of Appendix A. The line items correspond to those of Exhibit A-2, with some revisions.

(2) For the Upper and Lower Quartile plants, Total Assets were set equal to the value calculated for the median plant. Net Worth and Debt were then calculated using the ratio of Debt to Net Worth, and noting that Total Assets equal Net Worth plus Debt. This procedure was found to give the most reasonable financial statements in the absence of upper and lower quartile values for the ratio of Sales to Net Worth.

(3) Line items 6 and 13 from Exhibit A-2 were not required because the ratio of depreciation to net fixed assets was available directly from CCH data. In contrast, the EPA had available only the ratio of depreciation to gross fixed assets (taken from the Census of Manufacturers). This introduced two additional steps in their calculations that are not required here. To do their calculations, the EPA had to assume that the value of gross fixed assets was twice the value of net fixed assets.

(4) The allocation of financial ratios to the model plants reflects the grouping of ratios shown in Section 2i of Exhibit VIII-1a.

The starting point for the creation of model financial statements is the estimate of average firm sales. In our worked example this value was taken from the CCH data to increase the comparability with the worked example using CCH data. The ratio of depreciation to net fixed assets was also taken from CCH data, rather than from U.S. Census data, as in the case of the EPA example.

In other respects, our calculation of the pre-compliance model financial statements duplicates the approach taken by the EPA.

## Post-Compliance Financial Condition

Following calculation of the pre-compliance financial condition of the model plants (Exhibit VIII-1b), the next step was to modify this condition to reflect the capital and operating costs of abatement. This process is detailed in Exhibit VIII-1c. The capital cost of abatement equipment is financed by debt, leading to an increase in the plant's financial leverage, and increasing interest expenses. Operating costs also increase. Depreciation charges reduce reported net income, but not cash flow. Taxes are affected by the Capital Cost Allowance (CCA) allowed on pollution control equipment. The calculations in Exhibit VIII-1c incorporate these effects to produce estimates of the post-compliance financial condition.

## Ratio Tests To Predict Closure

At the bottom of Exhibit VIII-1c, values for the three ratios used to predict solvency are calculated, based on the post-compliance financial condition. It can be seen that the model plant in the lowest quartile of financial health is predicted to fail. After compliance, its return on assets is estimated to be negative, its debt to assets ratio is greater than 70 percent, and the ratio of cash flow to debt is less than 8 percent. Each of these ratios falls outside of the EPA's boundary for financial health.

Some points regarding our calculation of post-compliance financial statements bear making:

1. We assumed that pre-compliance net income before tax (book) was equal to pre-compliance taxable income. This is equivalent to assuming that, before compliance, the plant income statement did not have any deferred taxes.

2. The capital cost allowance (CCA) for abatement equipment was assumed to be 33 1/3 per year for 3 years. In practice, the following rates would apply: 25 percent in the first and third years, and 50 percent in the second year. By 'smoothing out'

Exhibit VIII-1c

## Dun & Bradstreet Worked Example
# Post-Compliance Financial Statements
($ thousands)

| LINE ITEM | | Upper Quartile Plant | Median Plant | Lower Quartile Plant | FORMULAS (1) |
|---|---|---|---|---|---|
| 20 | Pre-Compliance Net Income Before Taxes | 391.1 | 177.1 | 44.3 | (19) |
| 21 | Abatement Operating Expenses | 45.0 | 45.0 | 45.0 | (E) |
| 22 | Abatement Interest | 39.6 | 39.6 | 39.6 | (A) x (B) |
| 23 | Abatement Depreciation (Book) | 36.0 | 36.0 | 36.0 | (A) / (C) |
| 24 | Net Income Before Taxes | 270.5 | 56.5 | (76.3) | (20) - (21) - (22) - (23) |
| 25 | Plus: Abatement Depreciation | 36.0 | 36.0 | 36.0 | (23) |
| 26 | Less: Abatement CCA | 120.0 | 120.0 | 120.0 | (A) / 3 |
| 27 | Taxable Income | 186.5 | (27.5) | (160.3) | (24) + (25) - (26) |
| 28 | Income Tax (Current) | 85.8 | 0.0 | 0.0 | (D) x (27), if > 0 |
| 29 | Net Income Before Taxes | 270.5 | 56.5 | (76.3) | (24) |
| 30 | Income Tax (Current) | 85.8 | 0.0 | 0.0 | (28) |
| 31 | Income Tax (Deferred) | 38.6 | 26.0 | 0.0 | (32) - (30) |
| 32 | Total Income Taxes | 124.4 | 26.0 | 0.0 | (D) x (29), if > 0 |
| 33 | Net Income After Taxes | 146.1 | 30.5 | (76.3) | (30) - (32) |
| | Add: | | | | |
| 34 | Depreciation: - Pre-compliance | 112.5 | 116.6 | 198.3 | (14) |
| 35 | - Abatement | 36.0 | 36.0 | 36.0 | (23) |
| 36 | Income Tax (Deferred) | 38.6 | 26.0 | 0.0 | (31) |
| 37 | Subtotal Non-Cash Expenses | 187.1 | 178.6 | 234.3 | (34) + (35) + (36) |
| 38 | Post-Compliance Cash Flow | 333.2 | 209.1 | 158.0 | (33) + (37) |
| 39 | Pre-Compliance Debt | 874.7 | 1,393.6 | 1,671.1 | (10) |
| 40 | Abatement Capital Cost | 360.0 | 360.0 | 360.0 | (A) |
| 41 | Post-Compliance Debt | 1,234.7 | 1,753.6 | 2,031.1 | (39) + (40) |
| 42 | Post-Compliance Assets | 2,666.3 | 2,666.3 | 2,666.3 | (11) + (40) |
| | **Ratio Tests:** | | | | |
| 43 | Return on Assets | 5.5% | 1.1% | -2.9% | (33) / (42) |
| 44 | Debt/Assets | 46.3% | 65.8% | 76.2% | (41) / (42) |
| 45 | Cash Flow/Debt | 27.0% | 11.9% | 7.8% | (38) / (41) |
| | Failures: ROA < 2.5% | 0 | 1 | 1 | |
| | TD/TA > 70.0% | 0 | 0 | 1 | |
| | CF/TD < 8.0% | 0 | 0 | 1 | |
| | | 0 | 1 | 3 | |
| | **OVERALL RANKING** | **Pass** | **Pass** | **Fail** | |

Notes: (1) Letters appearing in the formulas refer to the assumed project costs listed in Exhibit VIII-1a

the CCA rate, our model statements represent the average impact over the first three years.

3. Where Taxable Income was positive, current income tax was calculated by multiplying Taxable Income by the assumed corporate tax rate (46%). Otherwise, current income tax was assumed to be zero.

4. Where Net Income Before Taxes was positive, total income tax was calculated by multiplying Net Income Before Taxes by the assumed corporate tax rate. Otherwise, total income tax was assumed to be zero.

5. Deferred tax was calculated subtracting current income tax from total income tax.

## *Example 2*

The CCH Financial Survey provides much more detailed information than Dun & Bradstreet on the average financial position of firms in an industry. The CCH survey presents data for more asset-size classes, as well as for more balance sheet and income statement items, than does Dun & Bradstreet.

Income statement items, in particular, are offered in more detail in the CCH survey. This allows us to add compliance cost estimates directly to the income statements presented, rather than having to 'construct' abbreviated income statements using ratios to work back from firm sales.

The disadvantage of the CCH data is that it does not provide information on the distribution of financial ratios, which Dun & Bradstreet does in a limited way through the presentation of quartile values. The trade-off is therefore one between the accuracy of the base financial statements as indicators of "average" financial condition, versus consideration of the variation in financial health between companies.

### Model Financial Statements

Exhibits VIII-2a and 2b show the income and balance sheets of a model plant created using CCH data. The format of these financial statements differs from those published in the CCH Survey; line items that do not change as a result of pollution abatement have, in many cases, been summarized as one number, and additional lines have been added to incorporate those expenses, assets, and liabilities associated with abatement activities.

**Exhibit VIII-2a**
**CCH WORKED EXAMPLE**
**Income Statement**

**CANADIAN IRON FOUNDRIES**
Canadian SIC Code: 294 (Assets $1M - $5M); Number of firms: 40

| Line Item | INCOME STATEMENT | INDUSTRY Baseline | FIRM Baseline | FIRM AFTER COMPLIANCE Year 1 | Year 2 | Year 3 | Year 4 | SOURCE |
|---|---|---|---|---|---|---|---|---|
| | | ($millions) | ($ thousands) | | ($ thousands) | | | |
| 1 | Sales | 158.3 | 3,958 | 3,958 | 3,958 | 3,958 | 3,958 | CCH |
| 2 | Other Income | 1.1 | 28 | 28 | 28 | 28 | 28 | CCH |
| 3 | Total Income | 159.4 | 3,985 | 3,985 | 3,985 | 3,985 | 3,985 | (1) + (2) |
| 4 | Operating Expenses - General | 146.4 | 3,660 | 3,660 | 3,660 | 3,660 | 3,660 | (CCH) |
| 5 | - Abatement | | | 45 | 45 | 45 | 45 | (E), see note (1) |
| 6 | Depreciation - General | 4.6 | 115 | 115 | 115 | 115 | 115 | CCH |
| 7 | - Abatement | | | 36 | 36 | 36 | 36 | (A) / (C), see note (1) |
| 8 | Interest on Abatement Debt | | | 40 | 40 | 40 | 40 | (A) x (B), see note (1) |
| 9 | Total Expenses | 151.0 | 3,775 | 3,896 | 3,896 | 3,896 | 3,896 | Σ (4) to (8) |
| 10 | Net Profit Before Taxes & | 8.4 | 210 | 89 | 89 | 89 | 89 | (3) - (9) |
| 11 | Non-Recuring Items | 0.0 | 0 | 0 | 0 | 0 | 0 | CCH |
| 12 | Net Income Before Taxes (Book) | 8.4 | 210 | 89 | 89 | 89 | 89 | (10) + (11) |
| 13 | Plus: Abatement Depreciation | | | 36 | 36 | 36 | 36 | (7) |
| 14 | Less: Abatement Capital Cost Allowance | | | 90 | 180 | 90 | 0 | See note (3) |
| 15a | Current Taxable Income | | | 35 | (55) | 35 | 125 | |
| 15b | Less: Loss Carry Forward | | | 0 | (55) | 35 | 20 | See note (4) |
| 15c | Adjusted Taxable Income | | | 35 | 0 | 0 | 105 | (15a) - (15b) |
| | Income Taxes | | | | | | | |
| 16 | Current | 2.5 | 62 | 16 | 0 | 0 | 48 | D x (15c), see note (1) |
| 17 | Deferred | 0.3 | 7 | 25 | 41 | 41 | (7) | (18) - (16) |
| 18 | Subtotal | 2.7 | 69 | 41 | 41 | 41 | 41 | D x (10), see note (1) |
| 19 | Net Income After Taxes (Book) | 5.7 | 142 | 48 | 48 | 48 | 48 | (12) - (18) |
| 20 | Cash Dividends Declared | 0.0 | 0 | 48 | 48 | 48 | 48 | (19) |
| 21 | Closing Retained Earnings | 39.4 | 985 | 985 | 985 | 985 | 985 | CCH |

Notes:
(1) Numbers referenced by a letter (A, B, C etc.) are taken from Exhibit VIII-1a, and reflect assumed costs for the abatement project.
(2) The numbers in this column are obtained by dividing the industry totals presented in the previous column by the number of firms in the industry.
(3) As per tax laws, 25% of the cost of the abatement equipment is written off in the first year, 50% in the second, and 25% in the third.
(4) Where taxable income is negative, the loss is carried forward to reduce positive taxable income in subsequent years.

**Exhibit VIII-2b**
**CCH WORKED EXAMPLE**
**Balance Sheet**

| Line Item | BALANCE SHEET | INDUSTRY Baseline | FIRM Baseline | FIRM AFTER COMPLIANCE Year 1 | Year 2 | Year 3 | Year 4 | SOURCE |
|---|---|---|---|---|---|---|---|---|
| | Number of Reporting Companies = 40 | ($millions) | ($ thousands) | | ($ thousands) | | | |
| 22 | Cash | 2.8 | 70 | 131 | 208 | 285 | 314 | (Baseline 22) + (29) + (38), see note (3) |
| 23 | Other | 57.2 | 1,430 | 1,430 | 1,430 | 1,430 | 1,430 | CCH |
| 24 | TOTAL CURRENT ASSETS | 60.0 | 1,500 | 1,561 | 1,638 | 1,715 | 1,744 | (22) + (23) |
| 25 | Fixed Assets - General | 81.7 | 2,043 | 2,043 | 2,043 | 2,043 | 2,043 | CCH |
| 26 | Fixed Assets - Abatement | | | 360 | 360 | 360 | 360 | Line (A), Exhibit VIII-1a |
| 27 | Subtotal | 81.7 | 2,043 | 2,403 | 2,403 | 2,403 | 2,403 | (25) + (26) |
| | Less: Accum'd Deprn | | | | | | | |
| 28 | - General | 52.6 | 1,315 | 1,315 | 1,315 | 1,315 | 1,315 | CCH |
| 29 | - Abatement | | | 36 | 72 | 108 | 144 | (Prior 29) + (7), see note (2) |
| 30 | | 29.1 | 728 | 1,052 | 1,016 | 980 | 944 | (27) - (28) - (29) |
| 31 | Land | 3.9 | 98 | 98 | 98 | 98 | 98 | |
| 32 | TOTAL FIXED ASSETS | 33.0 | 825 | 1,149 | 1,113 | 1,077 | 1,041 | (30) + (31) |
| 33 | Other Assets | 0.6 | 15 | 15 | 15 | 15 | 15 | CCH |
| 34 | TOTAL ASSETS | 93.6 | 2,340 | 2,725 | 2,766 | 2,807 | 2,800 | (32) + (33) + (24) |
| 35 | Total Current Liabilities | 35.3 | 883 | 883 | 883 | 883 | 883 | CCH |
| 36 | Other Liabilities | 18.1 | 453 | 453 | 453 | 453 | 453 | CCH |
| 37 | Debt for Abatement | | | 360 | 360 | 360 | 360 | Line (A), Exhibit VIII-1a |
| 38 | Incremental deferred taxes (1) | | | 25 | 66 | 107 | 100 | (Prior 38) + (17), see note (2) |
| 39 | Total Non-Current Liabilities | 18.1 | 453 | 837 | 878 | 919 | 912 | (36) + (37) + (38) |
| 40 | Total Liabilities | 53.4 | 1,335 | 1,720 | 1,761 | 1,802 | 1,795 | (35) + (39) |
| 41 | Total Equity | 40.2 | 1,005 | 1,005 | 1,005 | 1,005 | 1,005 | CCH |
| 42 | TOTAL LIABILITIES AND EQUITY | 93.6 | 2,340 | 2,725 | 2,766 | 2,807 | 2,800 | (40) + (41) |

Notes (1) Letters appearing in the formulas refer to the assumed project costs listed in Exhibit VIII-1a.
(2) The term "prior" means that the reference is to the indicated line item in the previous year.
(3) The term "baseline" means that the reference is to the indicated line item for the baseline, or pre-compliance firm.

The first column presents the aggregate values reported by CCH for the industry size class. The next column presents the financial statements of an 'average' plant, obtained by dividing the industry column by the number of companies in that size class (40 in our example).[1] This creates the 'baseline' financial condition of the model plant, which is its condition before it incurs compliance costs. This approach assumes that each firm corresponds to one plant.

The next four columns show the financial statements of the assumed model plant from one to four years after compliance. The same operating, financing and capital costs are assumed for abatement as were used in the Dun & Bradstreet example. We assumed no change in those expense and revenue items that are not related to abatement. The post-compliance financial statements were projected for four years to show the variation in reported cash flow because of the effect of deferred taxes.

## Tests For Closure

Exhibit VIII-2c shows the calculation of cash flow, and the values of those financial ratios used to test for bankruptcy. Return on assets and cash flow to total debt both fall as a result of compliance costs. The ratio of total debt to total assets increases because we assumed that the capital cost of abatement equipment would be financed with debt. Nevertheless, the plant fails only one of the EPA's financial ratio tests after compliance (that requiring a return on assets greater than 2.5 percent), and would not, therefore, be predicted to close. (The EPA's approach required a plant to fail at least two out of three tests before it would be predicted to close).

While the analysis using Dun & Bradstreet data shows the weakest model plant failing, the single-plant analysis using CCH data shows no failure. Thus the Dun & Bradstreet approach represents a more conservative estimate of the effects of compliance. Under the EPA method, failure of the weakest of the model plants (that corresponding to the lower quartile) results in the forecast closure of 25 percent of the plants in the category analyzed.

## Assumptions

In general, the same assumptions apply to the calculation of post-compliance income as were used in the Dun & Bradstreet example above.

Some exceptions and additional points should be noted:

---

1 In our example we have had to assume that firms are synonymous with plants, since we have no source of plant level data.

Exhibit VIII-2c

## CCH WORKED EXAMPLE
### Ratio Tests

| Line Item | | INDUSTRY Baseline ($ millions) | FIRM Baseline ($thousands) | FIRM AFTER COMPLIANCE Year 1 ($thousands) | Year 2 ($thousands) | Year 3 ($thousands) | Year 4 ($thousands) | Source |
|---|---|---|---|---|---|---|---|---|
| | **CASH FLOW FOR BEAVER'S RATIO** | | | | | | | |
| 43 | Net Income After Taxes | 5.7 | 141.5 | 48.3 | 48.3 | 48.3 | 48.3 | (19) |
| | Add: | | | | | | | |
| | Depreciation | | | | | | | |
| 44 | - General | 4.6 | 115.0 | 115.0 | 115.0 | 115.0 | 115.0 | (6) |
| 45 | - Abatement | 0.0 | 0.0 | 36.0 | 36.0 | 36.0 | 36.0 | (7) |
| 46 | Deferred Taxes (Total) | 0.3 | 6.8 | 24.8 | 41.1 | 40.9 | (7.4) | (17) |
| 47 | Total Non-Cash Expenses | 4.9 | 121.7 | 175.8 | 192.1 | 191.9 | 143.6 | (44) + (45) + (46) |
| 48 | Cash Flow | 10.5 | 263.3 | 224.1 | 240.4 | 240.2 | 191.9 | (43) + (47) |
| | **RATIO ANALYSIS** | | | | | | | |
| | 1. Return on Assets | 6.0% | 6.0% | 1.8% | 1.8% | 1.8% | 1.8% | (19) / (34) |
| | 2. Total Debt to Total Assets | 57.1% | 57.1% | 63.1% | 63.7% | 64.2% | 64.1% | (40) / (34) |
| | 3. Cash Flow to Total Debt | 19.7% | 19.7% | 13.0% | 13.7% | 13.3% | 10.6% | (48) / (40) |
| | **Failure Tests:** | | | | | | | |
| | 1. ROA < 2.5% | 0 | 0 | 1 | 1 | 1 | 1 | |
| | 2. TD/TA > 70.0% | 0 | 0 | 0 | 0 | 0 | 0 | |
| | 3. CF/TD < 8.0% . | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Number of Failures | 0 | 0 | 1 | 1 | 1 | 1 | |
| | EPA Status | Pass | Pass | Pass | Pass | Pass | Pass | |

1. The baseline financial statements presented by CCH include a positive value for deferred taxes. This shows that our assumption that pre-compliance book income equals pre-compliance taxable income is not true. Because the value for deferred taxes is small, however, the error introduced by this assumption is minor.

2. Cash dividends equal to net income were paid in each of the forecast years. This was done to keep the value of net worth at its pre-compliance level.

3. The cash flows associated with abatement-related non-cash expenses (depreciation and deferred taxes) were added to the cash account of the balance sheet.

4. A taxable loss was shown in year 2. The calculation of taxes in year 3 does not reflect the ability to carry such losses forward, which would reduce the taxes due.

5. The CCA rates used equal those allowed by Revenue Canada; namely 25% in the first year, 50% in the second, and 25% in the third.

## *Conclusions—Private Sector Examples*

Conceptually, there are two reasons why a private-sector firm may fail as a result of abatement regulations, while its competitors stay in business:

1. A plant that closes may be in a weaker condition financially than its competitors. This may reflect higher production costs that make it less able to absorb additional operating expenses, or a lack of the financial reserves (surplus cash or borrowing capacity) necessary to undertake investments in abatement equipment.

2. A plant may close if its marginal costs for abatement are substantially higher than its competitors. This may result if a plant uses a production process that is different from the industry norm, or is outdated.

Assuming that only a fraction of the plants in an industry close because of pollution abatement regulations, the process of forecasting plant closures must identify those plants that differ from the industry norm on one, or both, of the dimensions noted above.

### Estimation of Abatement Costs

Identifying plants that will incur higher abatement costs requires an analysis of their current levels of emissions, the characteristics of their production process, and an engineering analysis of the costs of abatement. This can probably only be done on an individual plant basis.

### Analysis Of Financial Condition

The EPA approach using Dun & Bradstreet data allows us to analyze some of the variability in firm financial condition that may result in plant closures. It does this in an arbitrary way, however, which may be useful only in those cases where there is a large number of firms (and therefore plants) in an industry, and where the approximations inherent in the methodology can "average out". In most Ontario industries, there is unlikely to be a sufficient number of firms to justify the use of the EPA's approacn to estimating model plant data.

Analysis of financial ratios using the CCH Survey will provide a picture of the financial condition of an "average" firm in an industry. It will not, however, provide an indication of the variability among firms, and therefore cannot be used to estimate the number of plants that may fail because they are owned by weaker-than-average firms. The ability of the CCH approach to illustrate the impact of abatement costs on an "average" firm, however, makes it a useful tool for evaluating the overall financial impact of abatement on an industry, but not for accurately predicting the number of plant closures.

Since both Dun & Bradstreet and the CCH Survey provide firm-level data, neither source provides information on the variability in financial condition among plants within one firm. This is a serious shortcoming for those industries in which most firms comprise more than one plant, especially if these plants are likely to be dissimilar. Therefore neither approach will estimate the number of financially-weak plants that may fail if these plants are "hidden" in financially healthy firms.

## *Municipal Example*

As noted in Chapter III, the EPA has used a number of financial ratios to test a municipality's ability to pay for abatement projects. The EPA calculates the values of various ratios and then compares them to threshold levels that mark the boundary of project affordability, or to a scale that indicates municipal financial health. Each of these ratio tests is applied individually, and the EPA provides no guidelines as to how the measures should be aggregated. In other

words, it is not clear how many ratios have to indicate poor financial health for the EPA to conclude that a municipality cannot afford to pay for an abatement project.

To illustrate the calculation of the EPA ratios, we have created a worked example by taking actual 1988 municipal financial data from the City of Sarnia, and then making arbitrary assumptions about the cost of a hypothetical sewer project. These assumptions are:

1. The capital cost of the project is $18.0 million. This cost is annualized over the project's useful life (10 years) by converting the capital cost into its equivalent annuity at an interest rate of 11 percent.

2. Annual operating expenses for the project are $2.5 million.

Financial figures for the municipality were taken from the Financial Information Return form (FIR) submitted by the City of Sarnia to the Ministry of Municipal Affairs for 1988. In the Exhibits, references are provided to the appropriate schedule, line and column in the FIR, for those figures where actual municipal financial data is used.

Exhibit VIII-3 summarizes some general statistics for the City of Sarnia, and the assumptions made about the hypothetical sewer project.

Exhibit VIII-4 shows the calculation of various ratios introduced in Exhibit III-5. These compare annual project cost to household income, and total municipal expenditures. Although the annual project cost per household was above the EPA's nominal $250 limit, in practice this limit should be increased to reflect inflation and currency differences. Annual project cost as a percent of municipal expenditures exceeded the EPA's guideline by a wide margin. In contrast, the annual cost as a percent of household income was well below the EPA's limits.

One of the EPA measures requires a value for the interest charges attributable to sewer facilities. The FIR form shows a municipality's total debt service charges, but does not disaggregate them by function. To allow us to estimate the EPA's coverage ratio, Exhibit VIII-5 allocates a portion of the city's total interest expense to sewer facilities on the basis of their proportion of long-term liabilities.

Exhibit VIII-6 illustrates the calculation of the EPA ratios introduced in Exhibit III-4. Baseline operating revenues directly attributed to sewer services (namely, the proceeds from the sewer surcharge on water billings) are much lower than operating expenses. This results in a very low operating ratio by EPA standards, and a negative coverage ratio. While this would appear to indicate extreme weakness in the municipality's ability to pay for additional

Exhibit VIII-3

# CITY OF SARNIA
## Financial Summary

| MARS References | | | | | | |
|---|---|---|---|---|---|---|
| | Sched | Line | Col | | | Source |
| | | | | **GENERAL STATISTICS** | **1988** | |
| A | | | | | | |
| B | 12 | 39 | 1 | Population | 46,448 | Planning Office, City of Sarnia |
| C | 12 | 44 | 1 | Households - water | 20,387 | F.I.R. - 1988 City of Sarnia |
| D | | | | - sewer | 20,387 | F.I.R. - 1988 City of Sarnia |
| E | | | | | | |
| F | | | | Personal income (per capita) | $17,200 | F.P. Canadian Markets 88/89 |
| G | | | | Household income | $39,187 | F.P. Canadian Markets 88/89 |
| H | | | | Total assessed value | $236,482,690 | Regional Property Assessment Office - Lambton |
| I | | | | Base year | 1950 | Regional Property Assessment Office - Lambton |
| J | | | | Equalization factor | 14.79% | Regional Property Assessment Office - Lambton |
| | | | | Estimated market value | $1,598,936,376 | (G) / (I) |
| | | | | **ASSUMED PROJECT COSTS** | | |
| | | | | Capital Cost | $18,000,000 | |
| | | | | Interest Rate | 11.00% | |
| | | | | Useful life | 12 years | |
| | | | | Annualized Capital Cost | $2,772,491 | |
| | | | | Annual Operating Expense | $2,500,000 | |
| | | | | **Total Annual Cost** | $5,272,491 | |
| | | | | **MUNICIPAL FINANCIAL DATA** | | |
| 1 | 4 | 51 | 7 | Revenue Fund Expenditures | $49,526,953 | F.I.R. - 1988 City of Sarnia |
| 2 | 2LT | 1 | 12 | Property Tax Revenue | $22,693,374 | F.I.R. - 1988 City of Sarnia |

**Exhibit VIII-4**

## MUNICIPAL WORKED EXAMPLE
**Measures of Municipal Ability To Pay For Sarnia in 1988**

Total Annual Project Cost = $5,272,491

Cost per household

= Total Cost/No. of households

= $5,272,491 / 20,387

= $258.62

(Above EPA Limit, See Exhibit III-5)

Cost as percent of median household income

= Cost per household/Household Income

= $258.62 / $39,187

= 0.66%

(Below EPA Limit, See Exhibit III-5)

Cost as % of total municipal expenditures

= Total Cost/Revenue Fund Expenditures

= $5,272,491 / $49,526,953

= 10.65%

(Above EPA Limit See Exhibit III-5)

Property Tax Revenue as % of Market Value

= EPA "Reliance on property tax revenues"

= Property Tax Revenue/Est'd Market Value

= $22,693,374 / $1,598,900,000

= 1.42%

("Strong", See Exhibit III-4)

Notes: (1) All dollar amounts, other than for estimated market value, are annual figures.

(2) All figures are taken from Exhibit VIII-3.

Exhibit VIII-5

## Municipal Worked Example
## Allocation of Debt Service Charges to Sewer Enterprises for Sarnia in 1988

| | MARS References | | | | | |
|---|---|---|---|---|---|---|
| | Schedule | Line | Column | | | Formula |
| | | | | **Long Term Liabilities for** | | |
| | | | | Enviornmental Services | | |
| (1) | 7 | 16 | 1 | Sanitary Sewer | $133,819 | |
| (2) | 7 | 17 | 1 | Storm Sewer | $916,211 | |
| (3) | | | | | $1,050,030 | |
| (4) | 7 | 51 | 1 | Total Long-Term Liabilities | $17,291,930 | |
| (5) | | | | % for Environmental Services | 6.07% | (3)/(4) |
| | | | | 1988 Total Debt Charges | | |
| (6) | 8 | 78 | 2 | Interest | $1,311,004 | |
| | | | | 1988 Debt Charges Allocated to Sewer Enterprise | | |
| (7) | | | | Interest | $79,611 | (5) x (6) |
| | | | | MOE Sewer Projects -- Debt charges | | |
| (8) | 8 | 48 | 3 | This municipality only | 0 | |
| (9) | 8 | 49 | 3 | Share of integrated | 0 | |
| (10) | | | | Allocated Interest Charges | $79,611 | (7) |
| (11) | | | | Total "Deemed Debt Services -- Sewers[1] | $79,611 | (8)+(9)+(10) |

1 The figure for 'Total "Deemed" Debt Services--Sewers' is used as an input to the coverage ratio calculated in Exhibit VIII-6 at line (27).

Exhibit VIII-6

# MUNICIPAL WORKED EXAMPLE

## Measures of Municipal Financial Condition for Sarnia in 1988

MARS References

| | Sched | Line | Col | | | Formula | Rating | Rating Source |
|---|---|---|---|---|---|---|---|---|
| | | | | *Revenue Fund Revenues* | | | | |
| (1) | 1 | 51 | 4 | Total Revenue: | $49,513,948 | | | |
| | | | | *Revenue Fund Expenditures* | | | | |
| (2) | 4 | 51 | 7 | Total: | 49,526,953 | | | |
| | | | | DIFFERENCE: | ($13,005) | (1) - (2) | | |
| (4) | | | | Percent: | -0.03% | (3)/(1) | Weak | Exhibit III-4 |
| | | | | **DEBT BURDEN** | | | | |
| (5) | 8 | 15 | 1 | Total | $17,291,930 | | | |
| (6) | | | | Per Capita | $372.29 | (5)/(A) | Strong | Exhibit III-4 |
| (7) | | | | As % of personal income | 2.16% | (6)/(F) | Strong | Exhibit III-4 |
| (8) | | | | As % of full market value | 1.08% | (5)/(J) | Strong | Exhibit III-4 |
| | | | | *Debt due*: | | | | |
| (9) | 8 | 60 | 1 | 1989 | $1,862,321 | | | |
| (10) | 8 | 61 | 1 | 1990 | 1,719,331 | | | |
| (11) | 8 | 62 | 1 | 1991 | 1,519,490 | | | |
| (12) | 8 | 63 | 1 | 1992 | 879,200 | | | |
| (13) | 8 | 64 | 1 | 1993 | 826,866 | | | |
| (14) | | | | Total: | $6,807,208 | (9)+(10)+(11)+(12)+(13) | | |
| (15) | | | | As percent of total debt due: | 39.37% | (14)/(5) | Strong | Exhibit III-4 |

(continued)

Exhibit VIII-6

## MUNICIPAL WORKED EXAMPLE

**Measures of Municipal Financial Condition for Sarnia in 1988**
**(continued)**

MARS References

| | Sched | Line | Col | | | Formula | Rating | Rating Source |
|---|---|---|---|---|---|---|---|---|
| | | | | **SEWER ENTERPRISE** | | | | |
| | | | | **Operating Revenues** | | | | |
| | | | | Sewer Surcharge on Direct water billings | | | | |
| (16) | 1 | 4 | 4 | - own municipality | $56,069 | | | |
| (17) | 1 | 5 | 4 | - other municipalities | 0 | | | |
| (18) | | | | Subtotal | $56,069 | (16)+(17) | | |
| | | | | Environmental Services | | | | |
| (19) | 3 | 16 | 1-4 | Sanitary sewer | $295,475 | | | |
| (20) | 3 | 17 | 1-4 | Storm sewer | 0 | | | |
| (21) | | | | Total | $351,544 | (18)+(19)+(20) | | |
| | | | | *Operating Expenses* | | | | |
| | | | | Environmental Services | | | | |
| (22) | 4 | 16 | 7 | Sanitary sewer | $1,090,800 | | | |
| (23) | 4 | 17 | 7 | Storm sewer | 0 | | | |
| (24) | | | | | $1,090,800 | (22)+(23) | | |
| (25) | | | | Operating Ratio (Revenues/Expenses) | 32.23% | (21)/(24) | Weak | Exhibit III-4 |
| | | | | Coverage Ratio | | | | |
| (26) | | | | Revenues less Expenses | ($739,256) | (21)-(24) | | |
| (27) | | | | Debt service | $79,611 | From Line (11) - Exhibit VIII-5 | | |
| (28) | | | | Ratio | (928.58%) | (26)/(27) | Weak | Exhibit III-4 |

sewer projects, it may simply reflect differences between the U.S. and Ontario in the financing of sewer projects. U.S. municipalities may typically fund all sewer operation expenses through user fees, for example, rather than relying, as Ontario municipalities do, on general tax revenues for a large portion of the funding for sewer operations.

The following is an explanation of certain definitions:

**Overall Net Debt:** this includes a locality's own debt as well as its share of the tax-supported debt of those governmental units wholly or partly within it, such as school boards and park districts. EPA documents indicate that it considers inclusion of such overlapping debts to be critical.

Municipalities do not consolidate their financial statements with local schoolboards, and therefore the MARS database does not include information on schoolboard debt. The financial position of other local boards, however, such as those for parks and recreation, libraries, and transit, are typically consolidated in the municipal financial statements. The debt position reported in MARS is therefore, between the EPA's definitions of direct net debt and overall net debt. For the purposes of rating the municipalities in the worked examples, we have assumed that the reported debt position ("Total Debt Burden") is equivalent to EPA's "Overall Net Debt."

**Overall Net Debt As A Percent Of Full Market Value:** this is the ratio of debt to the estimated market value of real property within the municipality. Market value is estimated by dividing the assessed value of real property by the current assessment ratio. The current assessment ratio corresponds to the equalization factor calculated for each municipality by the Ministry of Revenue.

## *Conclusions—Municipal Example*

The EPA provides no guidelines on what to do when its financial indicators give contradictory signals. On the one hand, for example, the financial health of the City of Sarnia would be rated as weak because it has a small operating deficit (see line 3 of Exhibit VIII-6). On the other hand, property tax revenue is, by EPA standards, only a small portion of the estimated market value of assessed property (see Exhibit VIII-4 and Exhibit III-4).[1] This gives a strong reading of the municipality's ability to pay, since, presumably, the City can afford to raise taxes.

---

1 The ratio of property tax revenue to estimated market value is referred to by the EPA as the "Reliance on Property Tax Revenues". A ratio smaller than 2 percent indicates a strong financial position.

The best measures of affordability would be those most closely related to the underlying population's ability to pay, and least influenced by accounting policies or the fiscal practices of the municipality. Thus, those ratios that relate abatement costs and debt burden to property value or household income are probably better measures of affordability than the ratios that express abatement costs as a percent of total municipal expenditures, or measure a city's operating deficit or surplus.

It is not clear how the EPA derived threshold values for its municipal financial indicators. To the extent that these values are somewhat arbitrary, someone seeking to apply the EPA ratios elsewhere could reasonably adjust the threshold levels if there were grounds to do so. Furthermore, the list of ratios used by the EPA certainly does not exhaust all of the possibilities, and more appropriate measures could probably be found for particular circumstances.

# Appendix A

# Appendix A: Case Studies

The application of the concept of economic achievability in the United States has been on a case-by-case basis. This Appendix describes how the financial measures noted in Chapter III of this paper, were used to assess economic impacts in the standard-setting process for three regulations. Each of these analyses were prepared by the U.S. EPA. Of particular note is the difference in approach used for each regulation.

The three case studies include:

- the metal molding and casting industry;
- the organic chemicals, plastics and synthetic fibres industry; and
- land disposal restrictions for hazardous waste.

These studies were selected from among a number of economic impact analyses for two reasons. First, they were often identified by officials at the U.S. Environmental Protection Agency as the "best" examples of EPA's analytic approaches.[1] Second, each represents a somewhat different approach to assessing "economic achievability." What follows in Exhibit A-4, at the end of this appendix, is a listing of all previously promulgated effluent guidelines and standards. Wherever BAT standards are set after 1977, there is an associated Economic Impact Assessment which has been carried out in conjunction with the standard.

## Background To Case Studies #1 and #2

The first two case studies – for the metal molding and casting industry; and the organic chemicals, plastics, and synthetic fibres industry – were drawn from EPA's effluent guidelines standards, which are promulgated under the Clean Water Act. Standards are set on an industry-specific basis. Exhibit A-1 lists the industries for which an economic impact analysis has been prepared as part of the standard-setting process.

---

1 Personal communications with Mr. Brett Snyder, U.S. EPA Office of Policy, Planning and Evaluation; Dr. Mark Lutner, U.S. EPA Office of Water; and Dr. David Schnare, U.S. EPA Office of Drinking Water.

EXHIBIT A-1

ECONOMIC IMPACT ANALYSES PREPARED UNDER THE CLEAN WATER ACT

| Promulgation of Regulation | Industry |
|---|---|
| 6-29-82 | Inorganic Chemicals |
| 8-22-84 | Inorganic Chemicals |
| 5-27-82 | Iron and Steel |
| 10-30-85 | Metal Molding and Casting |
| 12-3-82 | Ore Mining |
| 11-20-85 | Placer Gold Mining |
| 11-19-87 | Organic Chemicals and Plastics |
| 10-18-82 | Petroleum Refining |
| 11-18-82 | Pulp and Paper |
| 11-19-82 | Steam Electric |

Source: "The Regulation of Industrial Toxic and Hazardous Emissions in Ontario as Compared to Selected Jurisdictions," Volume II: Details of Regulations and Economic Impacts, MOE, April 1989.

Under Section 301 of the Clean Water Act, EPA is directed to establish regulations for the following categories:[1] [2]

> *Best Practicable Control Technology Currently Available* (BPT). These rules apply to existing industrial direct dischargers, and generally cover control of conventional pollutant discharge.
>
> *Best Available Technology Economically Achievable* (BAT). These rules apply to existing industrial direct dischargers and control of priority and non-conventional pollutant discharges more stringent than BPT.
>
> *New Source Performance Standards* (NSPS). These rules apply to new industrial direct dischargers and cover all pollutant categories.
>
> *Pretreatment Standards for Existing Sources* (PSES). These rules apply to existing indirect dischargers (whose discharges enter publicly owned treatment works). They generally cover the control of toxic and non-toxic conventional pollutant discharges that pass through the POTW or interfere with its operation. They are analogous to the BAT controls.
>
> *Pretreatment Standards for New Sources* (PSNS). These rules apply to new indirect dischargers and generally cover the control of toxic and non- conventional pollutant discharges that pass through the POTW and interfere with its operation.

For each of these standards, limitations, and guidelines, the EPA is required to carry out a regulatory impact analysis to analyze the economic consequences that could result from their application.[3]

The analysis is typically conducted on an industry-specific basis. EPA starts with an engineering assessment of available technologies and an evaluation of what each technology can achieve in terms of pollution control. The agency then selects different levels of abatement that are technically achievable, based on the engineering analysis. For each level of abatement,

---

1 U.S.C. et seq. as amended by Public Law 95-217.

2 It is important to note that in water programs, EPA sets water quality standards that must be met, but does not specify the technology to be used in meeting those standards. This is in contrast to the air quality program, where the regulations specify the type of control technology that must be used to meet standards.

3 In general, the terms "standards", "limitations", and "guidelines" are all synonymous. In addition, there are several different kinds of effluent limitations, guidelines and standards, according to what's being controlled (conventional or toxic pollutants) and type of source (existing or new). These are defined in Exhibit A-5.

EPA prepares an economic impact analysis to determine the effects of the regulation on industry. The economic impact analysis looks at the financial impacts that may occur at the individual plant or company level, and aggregates these impacts to determine the cumulative impact on the industry.

Under Section 308 of the Clean Water Act, the EPA is allowed to collect technical information and financial information for the last three years from firms. Firms may request that information contained in the survey be held confidential. It is optional for the EPA to conduct this survey. For the metal molding and casting industry, the EPA did not undertake a financial survey of firms in the industry because of the political pressures which existed at that time against carrying out a financial survey. EPA did however survey a sample of the industry to determine the types of discharging processes, the nature and amounts of effluent discharges, and plants operating characteristics typical of the industry. A survey was carried out however for the organic chemicals, plastics, and synthetic fibres industry a few years later under a different political climate.

## *Case Study #1: Metal Molding And Casting (Foundry) Industry*[1]

For the purpose of the EPA analysis, the foundry industry consists of plants that cast ferrous and/or nonferrous metals. The analysis carried out for the sector is reported by effects on an aggregate basis, as well as by metal used in the foundry process.

In 1984, there were an estimated 3,850 foundries employing more than 300,000 people. Many of these plants were privately owned jobbers which had no financial data in the public domain.

As a result of the lack of reliable financial data in the public domain and of not exercising the option to carry out a financial survey under the Clean Water Act, the EPA determined the economic impacts of the environmental regulations on surrogate plants ("model" plants). These model plants were developed by simulating base case financial statements for the foundries industry and incorporating estimated costs of compliance into the financial statements.

The primary measures of economic achievability used in this industry were plant closures and employment losses. Three post-compliance financial ratios (return on assets, total debt to total assets, and cash flow to total debt) were used to predict these measures. Where the financial ratios exceeded preset

---

1 This study is described in "Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Metal Molding and Casting (Foundry) Industry," United States EPA, 1985. Page numbers appearing in brackets in this Section of Appendix A, refer to this study.

threshold values for two of the three ratios, the affected foundries were considered potential closures.[1]

## Determining Plant Closures

There were four steps which the EPA undertook in order to measure plant closures. First, model or surrogate financial statements were developed for firms in the metal molding industry. Second, costs of compliance were estimated for the plants and incorporated into the financial statements. Finally, the impact of the compliance costs was measured using plant closure analysis.

### 1. Developing Model Financial Data

Financial and technical models of the plants were developed to represent the industry. To provide a broader picture of all of the firms in the industry, firms were subcategorized at several levels: by metal, by employment size category, by type of foundry (jobber or captive) and by financial status.

Metal Type

Data was subcategorized by metal type because EPA's research had shown that, in general, foundries casting a specific type of metal cast more than 90 percent of all production of that metal, and typically derived more than 90 percent of their revenue from casting the metal. As well, different metals have different end uses and compete in different markets.

The metals included in this analysis were:

| U.S. SIC | Metal | CDN SIC |
|---|---|---|
| 3321 | Grey Iron (except. ductile iron) | 2941 |
| 3321 | Ductile iron (includes 33212) | 2941 |
| 3322 | Malleable iron | 2941 |
| 3325 | Steel (includes 3324) | 2912 |
| 3361 | Aluminum | 2961 |
| 3362 | Copper, Brass, and Bronze (copperbase) | 2941 |
| 3369 | Zinc | 2999 |
| 3369 | Magnesium. | 2959 |

Employment Size Category

Five employment size segments were used to represent the varying employment in the industry. These were:

---

1 Ibid.

- fewer than 10 employees
- 10 to 49 employees
- 50 to 99 employees
- 100 to 249 employees, and
- 250 or more employees.

The sources of data used in the foundry study were as follows.

(i) Plant Survey

The EPA received information on 919 plants as a result of a partial survey of the foundry industry done in 1978. Since 1978, the EPA gathered information on an additional 347 plants, thereby gaining data on a total of 1,266 plants. This, however, represented only a fraction of the estimated 3,850 plants in the industry.

The survey provided plant-specific information on:

1. The types of metal cast.
2. The production process used.
3. The types and quantities of pollution discharge.
4. The mode of discharge (direct versus indirect).
5. The proportion of output sold to a related company.
6. The number of employees.
7. Sales and production quantities.

The focus of the survey was on collecting the information required to develop compliance cost estimates, rather than on collecting general financial data. The survey data allowed the EPA to estimate the proportion of discharging plants (by discharge mode), within any given metal and employment-size subcategory.

Substantial differences between metals were noted in terms of:

1. Casting processes used.

2. Fraction of plants discharging waste water.

3. The volume of waste water generation.

The actual number of plants within a given metal and employment-size subcategory was determined using a directory of the foundry industry. The survey data allowed the EPA to forecast the number of these plants that would incur compliance costs. For each discharging process within a subcategory, annualized compliance costs, for four different levels of abatement, were developed by the EPA.

(ii) Census Of Manufacturers

The Census of Manufacturers provided the quantity of shipments in 1982, and their total value. An average price per pound for each metal-type was derived by dividing the total quantity by the total value. This unit price was escalated to a 1983 value using appropriate indices.

The Census of Manufacturers also provided the ratio of depreciation to gross fixed assets for each 4-digit SIC category (corresponding to each metal type).

(iii) FINSTAT Data Base

The FINSTAT database is maintained by the Small Business Administration. The database combines records from Dunn & Bradstreet with records from Standard and Poor's COMPUSTAT database, which covers large, publicly-traded firms.

The EPA initially selected the financial records of approximately 2,000 firms whose SIC codes corresponded to the foundry industry. The EPA first discarded those records that failed tests of financial reasonableness. The EPA then discarded the records of firms which failed the EPA's financial criteria for closure. The EPA argued that this latter group of firms represented "baseline" closures, or, in other words, firms that would close regardless of EPA regulations. The EPA sought to identify only the incremental closures attributable to its regulations.

After editing, 1,302 firms remained in the database. For each metal and employment size subcategory, the EPA then calculated quartile values for each of the following financial ratios:

1. Sales to net worth.

2. Return on sales.

3. Debt to net worth.

4. Net fixed assets to net worth.

The EPA assumed that the ratios calculated above, developed for firms in the foundry industry, could be used to create model financial statements for plants.

Foundries were grouped into eight categories according to the type of metal used: within each such category, they were further divided into five size classes based on the number of employees. For each metal-type and size subcategory, three "model" pre-compliance financial statements were prepared,

corresponding to three levels of financial strength. A total of 120 model financial statements could have been required (this follows from 8 metal types x 5 size classes x 3 levels of financial strength). Only 87 were required, because some subcategories contained no discharging plants. In any subcategory, the EPA assumed that the financial statement corresponding to the lowest quartile of financial strength (as measured by return on sales) represented 25 percent of the plants. The financial statement corresponding to the "median" level of financial health was assumed to represent 50 percent of the plants. The remaining 25% of the plants were assigned to the highest quartile of financial strength.

The use of quartile values to develop financial statements allowed the EPA to model some of the variability in the financial strength of firms in the industry.

In developing the quartile data for a subcategory, each of the ratios was calculated for each of the firms contained therein. The calculated values for return on sales would then be ranked, and the median, and lower and upper quartile values selected. This process would then be repeated for each other financial ratio. In general, the firm providing the lower quartile value for return on sales would not correspond, for example, to the firm with the lowest quartile value for debt to net worth. In constructing the model financial statements, therefore, the EPA had to make some assumptions about how to group the quartile-based financial ratios.

The average plant production volume for each metal/size subcategory was calculated from the 1978 survey data. For the model plants, current dollar sales were then estimated by adjusting the 1978 average production volume to reflect the change in total industry volume, and multiplying the adjusted volume by the average industry price per pound calculated from Census of Manufacturing data (see above). In conjunction with the four financial ratios calculated from FINSTAT, the resulting estimates of model plant sales were used to estimate baseline, or pre-compliance, financial statements. A sample derivation of the pre-compliance financial statements for Aluminum, size 10 to 49 employees, is shown in Exhibit A-2.

The next step involved adjusting the model plants' baseline financial statements to reflect the costs of compliance. Take, as an example, the subcategory representing aluminum foundries with 10 to 49 employees. The 1978 plant survey had found that discharging foundries in that subcategory used a total of thirteen processes, or combinations of processes. Each process entailed a different treatment cost for a given discharge standard. For each process, the EPA developed compliance cost estimates for four different levels of abatement, reflecting four different proposed standards.

The EPA had no information on the relationship, if any, between firm financial health and the type of process used. Therefore, the EPA had to make the assumption that the proportion of foundries using a particular process was the same for each level of financial health.

EXHIBIT A-2

SAMPLE DERIVATION OF PRECOMPLIANCE FINANCIAL STATEMENTS

BASIS: ALUMINUM, 10 TO 49 EMPLOYEES
($ 000)

| | Upper Quartile | Median | Lower Quartile |
|---|---|---|---|
| 1. Sales (a) | 3167.50 | 3167.50 | 3167.50 |
| 2. Return on Sales (%) (b) | 6.44 | 4.67 | 3.17 |
| 3. Sales to Net Worth (b) | 2.76 | 3.85 | 5.93 |
| 4. Debt to Net Worth (%) (b) | 43.60 | 84.34 | 165.92 |
| 5. Fixed Assets to Net Worth (%) (b) | 6.25 | 28.43 | 59.17 |
| 6. Gross Fixed Assets to Net Fixed Assets (c) | 2.00 | 2.00 | 2.00 |
| 7. Depreciation to Gross Fixed Assets (%) (d) | 6.75 | 6.75 | 6.75 |
| 8. Net Income (1 x 2) | 203.98 | 147.92 | 100.41 |
| 9. Net Worth (1/3) | 1147.60 | 822.70 | 534.10 |
| 10.Debt (4 x 9) | 500.30 | 693.90 | 886.20 |
| 11.Total Assets (9 + 10) | 1648.00 | 1516.60 | 1420.30 |
| 12.Net Fixed Assets (5 x 9) | 71.70 | 233.90 | 316.00 |
| 13.Gross Fixed Assets (6 x 12) | 143.50 | 467.80 | 632.10 |
| 14.Depreciation (7 x 13) | 9.70 | 31.60 | 42.60 |
| 15.Cash Flow (8 + 14) | 213.66 | 179.52 | 143.00 |
| 16.ROA (8/11) (%) | 12.40 | 9.80 | 7.10 |
| 17.Debts/Assets (10/11) | 30.40 | 45.80 | 62.40 |
| 18.Cash Flow to Debt (15/10) (%) | 42.70 | 25.90 | 16.10 |
| 19.Gross Income (8 + adj. for taxes) | 354.50 | 250.80 | 162.80 |

a) Based on 308 survey data.
b) FINSTAT
c) Study of financial statements
d) Annual Survey of Manufacturers

Source: "Economic Impact Analysis of Effluent Limits, Guidelines, and Standards for the Metal Molding and Casting (Foundry) Industry", EPA, September 1985.

Accordingly, to represent aluminum foundries with 10 to 49 employees, 276 post-compliance financial statements had to be prepared, reflecting 3 levels of financial health x 13 processes x 4 treatment levels.

One of the financial criteria used by the EPA in predicting closure was cash flow to total debt. Cash flow is approximated by adding depreciation back to net earnings. Unfortunately, the FINSTAT data based did not contain a measure of depreciation. To estimate depreciation, the following steps were taken:

- The EPA examined 10K reports submitted to the Securities and Exchange Commission by publicly-traded companies. They noted that the ratio of net fixed assets to gross fixed assets ranged from 40 to 60 percent for most companies. The EPA then fixed the model plants' ratio of net to gross fixed assets at 50 percent.

- From the Census bureau's Annual Survey of Manufactures, the EPA found the ratio of depreciation to gross fixed assets for each 4-digit SIC code.

- The EPA doubled the ratio of net fixed assets to net worth (taken from the FINSTAT database) to obtain a measure of gross fixed assets to net worth. Since the net worth of each model plant could be estimated from the sales to net worth ratio also developed through FINSTAT, the EPA had a means of estimating each foundry's gross assets. Depreciation could then be estimated using the ratio of depreciation to gross fixed assets obtained in (2) above.

### 2. Incorporating Cost Estimates Into Financial Statements

The costs of abatement technologies were incorporated into the baseline projections to develop the post-compliance financial statements. It was assumed that compliance capital costs were financed entirely by debt and that straight line depreciation of the capital equipment over ten years would be used.

The costs of compliance (capital and operating and maintenance costs) were developed for four different levels of abatement (level one being the least stringent and level four being the most stringent).

### 3. Estimation Of Impacts/Financial Ratio Analysis

A plant closure analysis was carried out in order to estimate the impacts of the proposed standards, limitations, and guidelines. The analysis compared three ratios (one profitability and two solvency), derived from companies' financial statements after they had complied with the regulations, to three

threshold values that the ratios should fall into after the companies had complied with the regulations. The profitability measure used was return on assets; the two solvency tests used were total debt to total assets, and cash flow to total debt (known commonly as Beaver's ratio).

Where estimated post-compliance ratios exceeded the threshold values chosen two out of three times, the EPA assumed that the plant would close. Although plant closures and employment losses were used as the primary measure of economic impacts, other potential adverse impacts were examined including potential price impacts, potential production impacts, potential balance of trade impacts, and potential community impacts.

Based on the results of the economic analysis the EPA decided on how stringent the pollution control standards should be. Below is a more detailed explanation of the plant closure analysis which was carried out for the metal molding and casting industry.

(a) Return on Assets (ROA)

Return on assets was computed as the ratio of net income after taxes divided by total assets. Financial researchers have found that of the four profitability measures usually examined (refer to Exhibit III-3) in ratio analysis, ROA is the best in terms of its profitability predictive ability.

The threshold value chosen for ROA was based on a review of bankrupt firms. A value of 2.5% was chosen because this threshold was above that found for bankrupt firms, but below that normally found in the industry. ROA also has a strong advantage from the standpoint of availability because it requires only the net income and the total assets, both of which are reported in financial statements.

(b) Total Debt To Total Assets

Total debt to total assets generally refers only to current plus long-term liabilities, and does not include preferred stock,however, there is much debate over whether or not preferred stock should be included in the calculations. The EPA analysis included preferred stock because William Beaver, an expert in the area of financial analysis and other financial researchers found total debt plus preferred stock to be the best measure of debt.

The threshold value chosen for this indicator was based on a review of debt to asset ratios for the foundry industry. It was noted that some metals had debt to asset ratios above 60%, which some were as high as 68%. EPA chose a threshold value of 70% because it was above common values for the debt to asset ratio, but below the value before failure for known bankrupt firms.

(c) Cash Flow To Total Debt

In defining this ratio, cash flow consists of net income of a firm plus depreciation of a firm. Total debt includes all liabilities of the firm, including accounts payable, taxes payable, bank loans, and capitalized leases. Computationally, this ratio is very easy to derive from financial statements.

The threshold value for this ratio was selected to be 8%, based on a survey of bankrupt firms (page III-24).

## Results Of Economic Achievability Analysis

By creating pre-compliance financial statements for model foundries, and imposing compliance costs on the model financial statements, post-compliance financial conditions were estimated for plants in the industry. Where post-compliance financial statements failed two of the three ratio tests discussed previously, the number of firms estimated to have those financial statements were forecasted to fail. Because firms had been segmented by size and metal category, the EPA were able to estimate job losses from the number of plant closures.

These results of this analysis estimated that 800 foundries would incur aggregate capital costs ranging from $43.2 million under the least stringent guidelines, to $102.4 million under the most stringent guidelines. Operating costs ranged from $16 million to $47 million. (Note: all costs in 1983 U.S. dollars).

The number of plant closures ranged from 4 under the least stringent option to 24 with the most stringent option. Job losses ranged from 100 people to 724 people.

Aggregate results of all four levels of stringency are listed in the following chart:

Aggregate Estimated Impacts of Expenditures on Pollution Control Technologies
(Costs in millions of 1983 $U.S.)

| Stringency | Plant Closures (number) | Capital Costs | Annual Costs | Job Loss (number) |
|---|---|---|---|---|
| 1. (Lowest) | 4 | 43.2 | 16.2 | 100 |
| 2. | 7 | 81.2 | 36.0 | 181 |
| 3. | 13 | 90.2 | 41.7 | 387 |
| 4. (Highest) | 24 | 102.4 | 47.4 | 724 |

Selected stringency levels for BAT were the third level of stringency for all metals except for Steel and Aluminum which were based on the second level of stringency because of the high costs to these foundries. Magnesium was excluded from the regulation due largely to the effects of large compliance costs on the small plants in this subcategory of the foundries sector.

## Measuring Other Impacts

Other measures which were considered as part of the economic impact analysis were potential price impacts, potential production impacts, potential balance of trade impacts, community effects, and small business impacts. These measures provide additional information on the effects of the regulations.

### Price Impacts

When analyzing price impacts, the EPA assumed that foundries would have to absorb the full costs of the regulations and would not be able to pass along any cost to consumers. This assumption was based on estimates by EPA of competition in the market. As well, domestic producers indicated they were currently holding their prices down in response to foreign competition.

Although impacts were based on the above scenario, the EPA also estimated the price effects if all compliance costs were passed onto consumers in the form of price increases. The ratio of annual compliance costs to annual revenue for any sector would equal the maximum percentage price increase that would result if producers were able to pass all compliance costs on to consumers Potential price increases under this scenario were generally very low, increasing less than one percent. Under this scenario, plants were identified as potential closures if the required price increase exceeded three percent of current prices.

Both of these scenarios overestimate the impact of the regulations on the industry because in each case, all of the firms are expected to react the same way and absorb all of the costs or pass all of the costs through to consumers.

Both scenarios were applied to each sector to identify the range of impacts that could result, depending on the characteristics of the market.

### Production Impacts

To estimate potential production impacts, it was assumed that production capacity was proportional to sales. The proportion of sales accounted for by the model foundries forecasted to fail was assumed to equal the proportion of foundry production capacity lost.

It was estimated by EPA that these production losses would be small and could be made up by the remaining foundries in the industry.

### Balance Of Trade Impacts

To estimate potential impacts on the balance of trade, imports and exports of castings as stand-alone products and as components of other products were considered. The regulation was expected to have no significant impact on the U.S. balance of trade.

### Community Impacts

It was assumed that plant closures would be distributed nationally in the same manner as the total foundry population. This assumption was necessary because EPA was using model plants and not real foundries. Because of the low number of potential closures, EPA estimated the community effects would be small and scattered and were not significant.

### Small Business Impacts

After classifying the foundries by metal type and size, foundries with 50 employees or less were identified as small businesses and subjected to less stringent regulations if the EPA determined that the regulations were not economically achievable for the small plants.

In particular, for two metals, grey iron and malleable iron, EPA established less stringent standards for smaller foundries. The economic impacts on magnesium foundries were deemed to be sufficiently severe to warrant an exemption of the magnesium foundries from the regulation.

## *Case Study #2: Organic Chemicals, Plastics, And Synthetic Fibres (OCPSF) Industry*

For the purpose of the EPA analysis,[1] the OCPSF industry consists of plants that produce products classified in the following Standard Industrial Code (SIC) groups:

- plastics, synthetic resins, nonvulcanizable elastomers, US SIC 2821 (CDN SIC 3731)
- cellulose man-made fibres, US SIC 2823 (CDN SIC 1811)
- noncellulosic organic fibres, US SIC 2824 (CDN SIC 1811)
- cyclic crudes, and intermediates, US SIC 2865 (CDN SIC 1811), and
- industrial organic chemicals, not elsewhere classified, US SIC 2869 (CDN SIC 3712)

The EPA analyzed data from approximately 940 plants which produced an estimated 25,000 different products with both manufacturing and end-use applications. Of these 940 plants, 654 of these plants were expected to incur costs as a result of the regulations. Economic impacts of a range of options were evaluated for these plants.

Financial and economic data on the plants were collected in a survey carried out under section 308 of the Clean Water Act (CWA). The survey of the entire organic chemicals, plastics and resin manufacturing industry was conducted by EPA in 1983 and 1984 in order to collect data on manufacturing and wastewater discharges and treatment. The survey provided selected economic and operating information at the plant level. The economic data in the survey included product types, production quantities and values (sales), operating capacities, employment, capital expenditures, and some production costs.

There were 978 plants in the OCPSF survey database. Of these, 939 plants listed at least one OCPSF SIC code as being produced at the plant in the year requested by the survey. Twenty-two plants were not included in the industry analysis due to a lack of data. Where data gaps arose in the survey data, EPA attempted to estimate the missing data. A summary of the number of firms and plants surveyed, as well as data gaps which arose, are provided in Exhibit A-3.

---

1 "Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Organic Chemicals, Plastics and Synthetic Fibers Industry," United States EPA, September 1987. All page numbers bracketed in this Section of Appendix A refer to this study.

EXHIBIT A-3

SUMMARY OF 308 SURVEY DATA
FOR OCPSF PLANTS IN SCOPE[1]

| Variable | # of Plants with Data | # of Plants missing Data or Zero Values |
|---|---|---|
| Plant Employment | 935 | 4 |
| OCPSF Employment | 927 | 12 |
| OCPSF Production Quantity (tons) | 931 | 8 |
| Non-OCPSF Production Quantity (tons) | 431 | 508 |
| OCPSF Shipments Quantity (tons) | 919 | 20 |
| Value (M$) | 918 | 21 |
| Non-OCPSF Shipments Quantity (tons) | 433 | 506 |
| Value (M$) | 433 | 506 |

Note: 1 ton = 2000 lbs.
M$ = million dollars

1 These plants list at least one OCPSF SIC product group as produced at the plant at the time of the 308 Survey.

Source: "Economic Impact Analysis of Effluent Limitations, Guidelines, and Standards for the OCPSF Industry", US EPA, 1987.

As well, a summary of EPA's methodology for estimating missing survey data is contained in Attachment 1 to this Appendix.

Data were analyzed at the plant level, at the firm level, and at the national level. Plant level analysis examined costs from the perspective of corporate management to determine whether the corporation would be better off keeping a plant in operation or closing the plant and selling at liquidation value. Firm level analysis was performed from the perspective of stockholders and lending institutions who would provide sources of new equity or debt capital in order to assess the firms financial viability.

National level analysis was based on the results of the plant level analysis and examined the cost to society of regulations. This is discussed in more detail later in the paper.

## Measuring Economic Achievability

The primary measures of economic achievability at the plant level in this sector were plant closures and employment effects.

In the OCPSF industry real data were used to simulate managerial decision making on whether or not to close a plant. Three types of measures were used to estimate economic impacts at the plant level:

(1) plant closure or product line shut-down,
(2) change in profitability, and
(3) annualized costs as a percent of sales.

### Plant Closures

The purpose of this analysis was to determine the number and type of plants and product lines that were likely to close as a result of the regulations.

It was assumed in the analysis that a plant owner faced with pollution control requirements had to decide whether or not to make the additional investments in pollution control equipment, or whether to close the plants altogether. In general, EPA assumed that a plant owner would decide to continue operations if the present value of the future cash flows less the costs of investing in pollution control were greater than the expected liquidation value of the plant.

If the present value of the future cash flows less the costs of pollution control equipment were less then the liquidation value of the plant, than it was assumed that the owner would sell or close the plant.

Cash flow was calculated as net income plus after tax interest plus depreciation. The present value of the future cash flows were calculated by discounting the expected income stream by the weighted average cost of capital. Liquidation value was estimated to be 20 percent of a plant's net fixed assets plus its working capital (page 3-26).

The EPA developed regression equations to express a plant's liquidation value, cash flow and net income as a function of its total sales. The set of data points used to create these regression equations was taken from aggregated Dun and Bradstreet data. This progress, unfortunately, is not well-documented in the EPA report, so that it is not clear from what level of aggregation the ratios and sales data used to run the regressions were taken. The number of data points used in the regressions is much less than the number of plants in the 308 Survey, but it does not equal the number of firms either.

The individual plant data obtained through the 308 Survey was as follows:

1. Sales data (by product);

2. Production data (by product);

3. Employment levels (which are added to the tally of job losses if the plant closes);

4. Waste flows: which are used to calculate plant-specific treatment costs.

Plant-specific treatment costs are applied to the plant's assumed baseline financial condition, which is calculated by applying forecast plant sales to the regression equations for cash flow, liquidation value, and net income. In predicting plant closure, the Organic chemicals analysis therefore did not employ any plant-specific financial data other than forecast total sales. In the EPA analysis, the only variability in plant financial condition that was considered was that portion that was correlated with plant sales, and which was therefore captured by the regression equations.

In order to estimate the impacts of complying with the regulations on the industry, the EPA estimated the financial conditions of the industry at the time compliance would be necessary. This "baseline analysis" incorporated assumptions and forecasts of general macro-economic trends, as well as factors associated with overall industry health. The baseline year chosen for the OCPSF industry was 1988, for two reasons: 1) because compliance with the regulations would come on stream by that year for most companies, and 2) based on projections it was anticipated that it would be a typical year for the OCPSF industry representing neither a peak nor a trough in OCPSF production.

Once a plant was identified as being a candidate for closure, further analysis was carried out to determine whether or not the entire plant or only the OCPSF product lines would be likely to close. EPA assumed that if more than 80% of the plant's production workers were engaged in OCPSF manufacturing activities, the entire plant would close. Otherwise only the OCPSF product lines were projected to shut down.

### Change in Profitability

In order to measure the change in profitability, plants in the industry were categorized by their four digit SIC category. Plants were also categorized as either primary or secondary OCPSF producers. Primary producers were those with at least 50% of their total production value in OCPSF products, while secondary producers produced less than 50% of their total production in OCPSF products.

The EPA determined in its analysis that a profitability impact was significant when a plant's profit to sales ratio fell into the lowest decile (the bottom 10%) for the SIC and size category. The EPA noted that a substantial decline in profitability might signal a significant, but less immediate impact. For example, a firm might not decide to close a plant based on decreased profitability only, but might cease to reinvest in the plant's building and equipment, eventually closing it.

### Cost As A Percent Of Sales

Annualized treatment cost as a percentage of sales was used as another indicator of the relative magnitude of economic impact by the EPA. The analysis assumed that no costs could be passed to the consumer.

However, this ratio indicates the price increases needed if 100% of the costs were passed through. Cost-to-sales ratios in excess of 5 percent were assumed to represent a significant impact on the plant.

### Firm-Level Analysis

Two factors in particular were examined at the level of the firm: the ability of the firm to meet its fixed cost obligations and its attractiveness to financial institutions and investors.

Ability to meet fixed cost obligations is measured by a firm's current ratio and its interest coverage ratio. Attractiveness to investors is measured by leverage (measured by the firm's debt to its worth) and the firm's return on assets.

These ratios were estimated for all firms in the industry and then using these measures a baseline profile of firms were developed. Establishing baseline industry data was an attempt by the EPA to duplicate the process a bank would go through in developing loan decision making criteria. Once baseline data were established individual firms were compared to the data. Firms were characterized as financially vulnerable if they were highly leveraged and had a low return on assets.

## Results Of Economic Achievability Analysis

Aggregate costs presented for a range of BAT options ranged from $359 million to $1.3 billion (in 1982 U.S. dollars) for capital expenditures and $155 million to $617 million for operating expenditures. Plant closures ranged from a low of 8 closures to a high of 26, while product line shut- downs ranged from 10 to 16 lines. Employment losses were estimated to be between 1335 and 6475 jobs.

A summary of aggregate costs is presented below, with regulatory option one being the least stringent option and regulatory option 4 being the most stringent.

Summary of Estimated Economic Impacts on the OCPSF Industry
(costs in million of 1982 U.S. Dollars)

| Regulatory Option | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Capital Investment | 359 | 526 | 516 | 1,294 |
| Operating and Maintenance | 155 | 270 | 197 | 617 |
| Plant Closures (plants) | 8 | 12 | 11 | 26 |
| Product Line Shut-Downs (lines) | 10 | 12 | 9 | 16 |
| Profit or Sales Impact* | 15 | 29 | 25 | 52 |
| Employment Reduction (people) | 1,335 | 1,743 | 1,359 | 6,475 |

* Non-Closures only

## Measuring Other Impacts

Other measures that were examined in the economic impact analysis taken into consideration when determining appropriate effluent limitations, guidelines, and standards were: community impacts; the effects of the regulation on small businesses; impacts on international trade; potential impacts on new competitors into the industry; and the national social costs of the regulations.

A brief discussion follows below which outlines how the impacts of the above measures have been analyzed and the results of the analysis which were completed.

### Community Impacts

Community impacts were based on employment losses in a community. The significance of an impact on a community was determined by the ratio of employment lost from plant or product line closures to the population of the community. A community in which this ratio was 0.44 percent or greater after the comparison was considered to be significantly impacted.

Secondary effects on the community in terms of effect on community earnings were estimated by using an earnings multiplier analysis.

The EPA analysis on communities showed that the community impacts were not significant, with only two or three communities estimated to have significant impacts because of the regulations.

### Small Business Analysis

A small business analysis was carried out to determine if significant impacts occurred on small businesses as a result of the proposed regulation. If there was a significant impact, the Regulatory Flexibility Act requires EPA to develop an assessment of regulatory alternatives for the small businesses.

It was determined by preliminary analysis that there were significant and disproportionate adverse impacts on small plants. A detailed analysis was carried out on these plants which suggested different regulations for the OCPSF small businesses. For businesses in the OCPSF industry whose annual production was less than or equal to five million pounds, EPA set less stringent regulations.

### International Trade Impacts

There were two aspects to determining the impacts on international trade. The first was to determine the product's sensitivity to foreign competition while the second was to analyze the balance of trade impacts.

Trade sensitive products were identified by using the following criteria:

1. Excess foreign production capacity of at least 10% of U.S. production; and

2. Transport costs low enough to allow international trade at modest price differentials (exports plus imports exceeding 15% of production in 1988);or

3. A significant decline in net exports expected between 1985 and 1988 (page 3-38)

Products that met these criteria were defined to be trade sensitive, and analyzed by the plant closure procedure described previously. For the non-sensitive parts of the industry, plat closure analysis was also carried out. EPA estimated that for non-sensitive parts of the industry, plant closures were probably overstated in the analysis.

To estimate the balance of trade impacts EPA assumed that the total world demand for production would remain as projected for 1988, and then traced the effects of predicted plant closures on imports and exports. Exports were reduced by the amount of lost production in the industry. If the change in production was greater than exports, then any residual production loss was taken from domestic use. It was assumed that to make up the demand for domestic use, new imports would arise.

Results of the trade impact analysis for this sector indicated a number of trade sensitive products. Exports in thermosets was estimated to decrease by 10% with the regulation (a loss of $3.1 million annually), while exports of cyclic and acrylic chemicals were thought to be affected by approximately $50 million per year.

Impacts on the balance of trade were estimated to be negligible.

### Potential Impacts On New Competitors

Potential impacts on new competitors are measured by two factors: 1) increase in construction costs due to the need to comply with the regulation, and 2) the decrease in the net present value of cash flow and decrease in the profitability index (net present value/investment) due to capital and operating costs of the technology.

EPA concluded that the capital costs of compliance for the proposed regulations did not present a barrier to entry in the industry.

## National Social Costs Of The Regulations

Executive Order 12291, was intended to ensure that regulatory agencies evaluate the need for taking regulator action, consider available alternative actions, and design their programs on the basis of the costs and benefits of the various alternatives. In particular, the Order established a set of regulatory reform and review procedures, including a requirement that regulations be analyzed in terms of their total cost to society.

Social costs of the effluent limitations, guidelines and standards were defined by the EPA as:

> ".. the value of goods and services lost by society resulting from the use of resources to comply with a regulation, the use of resources to implement a regulation, and reductions in output due to compliance" (page 3-43)

Total national social costs of the regulations were defined to be equal to the sum of four components:

- Real Resource Costs: total expenditures on abatement and compliance in the private sector;
- Deadweight Welfare Loss: decreases in consumer and producer surplus resulting from a decrease in production;
- Adjustment Costs for Unemployed Resources:lost wages of laid-off workers while searching for new employment; and
- Government Administrative Costs: the incremental effort needed to monitor and enforce the regulations.

Real resource costs were taken to be the total expenditures on abatement and compliance in the private sector with two adjustments. First, since firms receive tax benefits when they invest in and operate abatement facilities, these are taken as costs to society and added back into the firms' actual outlays.

The second adjustment incorporates a discount rate used for annualized capital costs or for calculating the present value of streams of expenditures made over time. For the social cost analysis, two alternative social discount rates were used: 1) 10 percent, since EPA had recently used 10 percent as a social discount rate in its analyses, and 2) the current yield on long-term government securities, since this reflects the current opportunity cost of capital to government.

The deadweight welfare loss was estimated by measuring the economic profits that would have been earned by plants that were forced to close as a result of the guidelines. Economic profit was defined as the difference between the actual return earned by the firm and the "normal" return earned in the long run by the average firm in the industry.

The major adjustment cost incurred by unemployed workers was the loss of wages during the time spent searching for a new job. This cost was estimated by multiplying the daily wage times the number of days of average duration of unemployment times the number of number of workers laid off at closed plants.

Government administrative costs were estimated to be insignificant because the administrative system and staff were already in place.

Total national social costs of the regulations were estimated to range from $58.5 million (1982 U.S. for the least stringent regulation to $287 million (1982 U.S.). Figure 1 illustrates how the results of the national social cost estimates were considered with the rest of the analyses for this industry.

## *Case Study #3: Land Disposal Restrictions For Hazardous Wastes*

In the 1984 Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA), Congress directed the EPA to restrict the land disposal of hazardous wastes if the Agency determined that continued land disposal of the wastes were not protective of human health and the environment.

The EPA was required by HSWA to set a schedule for making land disposal restriction decisions for all hazardous wastes listed under RCRA (except those wastes which were prohibited).

The schedule submitted to Congress divided all schedule wastes into three groups based on a ranking which considered their intrinsic hazard and volume. Decisions regarding the land disposal of wastes with high intrinsic hazard and high volume were to be made first and the decisions low volume wastes with lower intrinsic hazard were to be made last.

The Agency was directed to promulgate land disposal restrictions – including treatment standards – for the first one-third of the schedule hazardous wastes by August, 1988. These waste are referred to by EPA as "first third wastes".

The following describes the economic analysis prepared as part of the RIA for first third wastes. Data used in the analysis were from the Manufacturers

Survey data and the U.S. census. Data on production costs were collected in 1987 by an EPA survey of hazardous waste treatment, storage, disposal, and recycling facilities (TSDR).

### Measuring Economic Achievability

The EPA compared the after-tax costs of complying with the first third treatment standard to estimates of the overall cash flow and production costs of firms in the affected industries. The analysis was used to determine which firms would be significantly affected or likely to close because of the regulation.

Two financial ratios were used to assess economic impacts on industries. The cost of production ratio was the first ratio estimated. It was derived by dividing the compliance cost by the cost of production and represented the percent product price increase for facility output that would occur if the entire compliance cost was passed through to customers in the form of higher prices.

The cash from operations ratio, was the second ratio estimated by dividing the cash from operations by the compliance cost. This ratio represented the number of times that the facility cash flow from operations could cover the regulatory compliance cost if the facility fully absorbed the cost.

### Determining Plant Closures

In determining plant closures, EPA estimated that closure would occur for facilities whose cash flow from operations divided by compliance cost ratio was less than two.[1] This low ratio indicated that half of the facilities cash from operations in needed to comply with the first third land disposal restrictions.

### Small Business Analysis

Due to data limitations, an analysis of impacts on generators,[2] which represent over 90% of all facilities that manage first third wastes, was not carried out. In this case, the agency used the same regulatory standards for large generators as for small.

---

1 "Regulatory Impact Analysis of the Land Disposal Restrictions on First Third Wastes", United States EPA, August 1988, pg. 4-10.

2 Generators are those facilities that store wastes for less than 90 days and send their wastes off-site for final treatment or disposal. Wastes are processed on a fee basis.

## Replacement Estimates For Missing 308 Survey Data[1]

For plants missing 308 Survey production and sales data, the following methods were used to estimated replacement values. Missing production/sales data fell into 7 distinct categories:

1) Total quantity produced (all purposes) missing only;

2) Quantity shipped missing only;

3) Value of shipments missing only;

4) Both total quantity and value of shipments missing;

5) Both quantity and value of shipments missing;

6) Both total quantity produced and value of shipments missing; and

7) Total quantity, quantity shipped, value of shipments missing.

Replacement values were estimated for categories 1-6 only. Missing data were filled using two ratios:

1) production/shipment ratio; and

2) unit price, equal to the quantity of shipments divided by the value of shipments.

For both of these ratios, median values for individual SIC codes were used. Median values were used because mean statistics had extremely large variances resulting from a few extreme values (e.g. high-priced, low-volume specialty products). In determining production/shipment ratios, it was found that a 1:1 relationship generally existed between total production and quantity of shipments. For the purposes of the data replacement methodology, total production and quantity of shipments were assumed to be equal. Median unit price values were calculated for 8-digit SIC codes. If median unit prices could not be fixed for 8-digit SIC codes, 4- digit codes were used. In the event that unit prices for 4-digit codes could not be fixed, 3-digit SIC codes were used.

---

1 Source: "Economic Impact Analysis of Effluent Limitations, Guidelines and Standards for the OCPSF Industry" US EPA, 1987.

In cases where unit prices for 3-digit SIC codes could not be determined, unit prices were not used.

Missing data were estimated as follows:

1) Total quantity missing only: total quantity set equal to quantity of shipments;

2) Quantity shipped missing only: quantity shipped set equal to total quantity produced;

3) Value of shipment missing only: value of shipments set equal to quantity shipped multiplied by unit price; and

4 Both total quantity and quantity of shipments missing: quantity of shipments set equal to the value to shipments divided by unit price. Total quantity set equal to quantity of shipments.

EXHIBIT A-4

SUMMARY OF EPA EFFLUENT GUIDELINES AND STANDARDS

| Category | Standards | Promulgation Date |
|---|---|---|
| Aluminum forming | BPT, BAT, NSPS, PSES, PSNS | 12/27/88 |
| Asbestos manufacturing | BPT, BAT, NSPS, PSES, PSNS | 4/25/75 |
| Battery manufacturing | BPT, BAT, NSPS, PSES, PSNS | 8/28/86 |
| Builder's paper and board mills | BPT, BCT, BAT, NSPS, PSES, PSNS | 12/17/86 |
| Carbon black manufacturing | BAT, NSPS, PSNS | 1/9/78 |
| Cement manufacturing | BPT, BCT, BAT, NSPS, PSES, PSNS | 8/29/79 |
| Coal mining | BPT, BAT, NSPS | 10/9/85 |
| Coil coating | BPT, NSPS, PSES, PSNS | 8/24/84 |
| Copper forming | BPT, BAT, NSPS, PSES, PSNS | 6/20/86 |
| Dairy products processing | BPT, BCT, NSPS, PSES, PSNS | 7/9/86 |
| Electroplating | PSES | 9/4/84 |
| Electrical and electronic components | BPT, BAT, NSPS, PSES, PSNS | 1/31/85 |
| Explosive manufacturing | BPT | 3/9/76 |
| Feedlots | BPT, BAT, NSPS, PSES, PSNS | 2/11/75 |
| Ferroalloy manufacturing | BPT, BCT, BAT, NSPS, PSNS | 7/9/86 |
| Fertilizer manufacturing | BPT, BCT, BAT, NSPS, PSNS | 7/29/87 |
| Fruits and vegetables processing | BPT, BCT, NSPS, PSES, PSNS | 7/9/86 |
| Glass manufacturing | BPT, BCT, BAT, NSPS, PSNS | 7/9/86 |
| Grain mills manufacturing | BPT, BCT, NSPS, PSES, PSNS | 7/9/86 |
| Gum and wood chemicals manufacturing | BPT | 5/18/76 |
| Hospitals | BPT | 5/6/76 |
| Ink formulating | BPT, BAT, NSPS, PSNS | 7/28/75 |
| Inorganic chemicals | BPT, BAT, NSPS, PSES, PSNS | 9/25/84 |
| Iron and steel manufacturing | BPT, BCT, BAT, NSPS, PSES, PSNS | 5/17/84 |
| Leather tanning and finishing | BPT, BCT, BAT, NSPS, PSES, PSNS | 3/21/86 |
| Meat products | BPT, BCT, PSES, PSNS | 7/9/86 |
| Metal finishing | BPT, BAT, NSPS, PSES, PSNS | 11/7/86 |
| Metal molding and casting | BPT, BAT, NSPS, PSES, PSNS | 6/16/86 |
| Mineral mining and processing | BPT | 3/10/78 |
| Nonferrous metals forming and metal powders | BPT, BAT, NSPS, PSES, PSNS | 4/4/89 |
| Nonferrous metals manufacturing | BPT, BAT, NSPS, PSES, PSNS | 1/21/88 |
| Oil and gas extraction (Stripper subcategory) | BPT | 7/21/82 |
| Ore mining and dressing | BPT, BAT, NSPS | 5/24/88 |
| Organic chemicals, plastics and synthetic fibers | BPT, BAT, NSPS, PSES, PSNS | 6/29/89 |
| Paint formulating | BPT, BAT, NSPS, PSNS | 7/28/75 |
| Paving and roofing materials (tars and asphalt) | BPT, BAT, NSPS, PSNS | 7/24/75 |
| Pesticide chemicals (Manufacturing subcategory) (Formulating/Packaging subcategory) | BPT | 9/29/78 |
| Petroleum refining | BPT, BCT, BAT, NSPS, PSES, PSNS | 8/12/85 |
| Pharmaceutical manufacturing | BPT, BCT, BAT, NSPS, PSES, PSNS | 12/16/86 |
| Phosphate manufacturing | BPT, BCT, BAT, NSPS | 7/9/86 |
| Photographic | BPT | 7/14/76 |
| Plastics molding and forming | BPT, BCT, BAT, NSPS, PSES, PSNS | 12/17/84 |
| Porcelain enameling | BPT, BAT, NSPS, PSES, PSNS | 9/6/85 |
| Pulp, paper, and paperboard | BPT, BCT, BAT, NSPS, PSES, PSNS | 12/17/86 |
| Rubber manufacturing | BPT, BAT, NSPS, PSNS | 4/25/75 |
| Seafood processing | BPT, BCT, NSPS, PSES, PSNS | 7/9/86 |
| Soap and detergent manufacturing | BPT, BAT, NSPS, PSES, PSNS | 2/11/75 |
| Steam electric power generating | BPT, BCT, BAT, NSPS, PSES, PSNS | 7/8/83 |
| Sugar processing | BPT, BCT, NSPS, PSES, PSNS | 7/9/86 |
| Textile mills | BPT, BAT, NSPS, PSES, PSNS | 9/1/83 |
| Timber products processing | BPT, NSPS, PSES, PSNS | 2/12/81 |

## EXHIBIT A-5
## DEFINITIONS OF EFFLUENT LIMITATIONS, GUIDELINES AND STANDARDS—U.S. EPA

Effluent Limitation—The term "effluent limitation" means any restriction established by the EPA Administrator on quantities, rates, and concentrations of chemical, physical, biological and other constituents which are discharged from point sources, into navigable waters, the waters of the contiguous zone or the ocean. 40 CFR § 401.11(i)

Effluent Limitations Guidelines—The term "effluent limitations guidelines" means any effluent limitations guidelines issued by the EPA Administrator pursuant to section 304(b) of the Federal Water Pollution Control Act. 40 CFR § 401.11(j)

Performance Standards—The term "standard of performance" means any restriction established by the EPA Administrator pursuant to section 306 of the Federal Water Pollution Control Act on quantities, rates, and concentrations of chemicals, physical, biological, and other constituents which are or may be discharged from new sources into navigable waters, the waters of the continguous zone or the ocean. 40 CFR § 401.11 (k)

Pretreatment Standards—The term "National Pretreatment Standard", "Pretreatment Standards", or "Standard" mean any regulation containing pollutant discharge limits promulgated by EPA in accordance with section 307(b) and (c) of the Federal Water Pollution Control Act, which applies to Industrial Users. This term includes prohibitive discharge limits established pursuant to § 403.5. 40 CFR § 403.3(j)

Source: Federal Register, Vol. 52, No. 214, pg. 42525.

# Appendix B

# Appendix B: Financial Ratios As Predictors Of Bankruptcy

As part of its study into the foundry industry, the EPA undertook an intensive review of the academic literature on the use of financial ratios to predict business failure. This review was prompted by public comments questioning both the ratios used, and the threshold values selected. A comparison of the seven most promising univariate financial ratios, as determined by EPA and discussed in Chapter III of this report, is provided in Exhibit B-1.

The majority of studies reviewed by the EPA, and all of the most recent ones, proposed the use of multivariate functions to predict bankruptcy. The trend in the literature towards multivariate functions was initiated by Edward Altman, who published a widely-read article in 1968. Altman applied multiple discriminant analysis (MDA) to a sample of 66 manufacturing corporations, 33 of which had failed. Multiple discriminant analysis is a statistical technique that attempts to produce a linear equation that "best" predicts into which of two groups a particular member of the sample will fall.

The equation proposed by Altman contained the following financial ratios:

1. Net working capital/total assets;
2. Retained earnings (book)/total assets;
3. Earnings before interest and taxes (EBIT)/total assets;
4. Market value of common and preferred shares/book value of debt;
5. Sales/total assets.

These ratios were considered to be, respectively, measures of:

1. Liquidity;
2. Leverage;
3. Profitability;
4. Solvency;
5. Activity.

EXHIBIT B-1

COMPARISON OF UNIVARIATE RATIO TESTS

| Test | Data Required | Data on Hand | Issues |
|---|---|---|---|
| ROA | 1. Net Income<br>2. Assets<br><br>Can be computed from:<br><br>• ROA plus assets;<br>• ROA plus net income;<br>• Net income plus assets. | Dun & Bradstreet:<br><br>ROA (as ratio) and total assets—median values by 4 digit SIC/asset size class—1979-1982.<br><br>Iron Castings Society:<br><br>Mean "capital employed" by sales class aggregate for iron foundries.<br><br>Steel Founders' Society:<br><br>Profit before taxes and "capital employed" by sales level-aggregate for steel foundries.<br><br>Robert Morris Associates:<br><br>Median profit before taxes/total assets plus average assets, by asset size class. Data only for all ferrous and all non-ferrous foundries.<br><br>FINSTAT:<br><br>Individual company data from 1977-1980 giving employment and data asset size from Dun & Bradstreet data base. | To calculate employment effects, would like to have relationship between assets or net income and employment.<br><br>Use of median values by size category only allows one test to be made for each size class.<br><br>Median assets need not correspond to median ROA, leading to use of incompatible data.<br><br>Use of before tax earnings ratio would require guess of tax structure. |

(Continued)

| Test | Data Required | Data on Hand | Issues |
|---|---|---|---|
| EBIT/Total Assets | 1. Earnings Before Interest And Taxes<br><br>2. Assets<br><br>EBIT can be obtained:<br><br>- Directly from corporate financial statement;<br><br>- From ratio plus total assets;<br><br>- From net income plus taxes plus interest. | Dun & Bradstreet:<br><br>Median total assets<br>Median ROA<br>Median total liab. to NW<br>Median Current liab. to NW<br><br>Median Return on NW<br>- derive long term liab. to assets<br>- guess interest rate<br>- guess tax rate<br>- calculate EBIT/total assets.<br><br>Robert Morris Associates:<br><br>Median EBIT/interest<br><br>Median Profit before taxes/total assets (can be combined to EBIT/total assets) average assets by asset size category.<br><br>Steel Founders' Society:<br><br>Average profit before taxes<br>Average total assets<br>- no data relevant to interest payments.<br><br>Iron Castings Society:<br><br>Average operating<br>Average capital employed<br>- no data relevant to interest payments. | Multiplication of medians does not necessarily lead to median value of another ratio.<br><br>Potential error in guessing tax rates, interest payments.<br><br>D&B provides no data on average or median tax payments.<br><br>RMA asset sizes are not the same as Dun & Bradstreet, and do not correspond to SRI.<br><br>RMA data is only available at level of ferrous or non-ferrous foundries. |

(Continued)

| Test | Data Required | Data on Hand | Issues |
|---|---|---|---|
| EBIAT/Total Assets | 1. Earnings Before Interest And After Taxes (EBIAT)<br>2. Total Assets<br>EBIAT requires EBIT plus taxes. | Same as for EBIT/Total Assets | Same restrictions and issues as for EBIT, plus the requirement of additional calculation. |
| ROS | 1. Net Income<br>2. Sales<br>Can be derived from ROS ratio plus either net income or sales. | Dun & Bradstreet:<br>Median ROS<br>Median net income<br>Median sales.<br>Robert Morris Associates:<br>Median sales/total assets<br>Median EBT/total assets<br>Median EBT/sales.<br>Steel Founders' Society:<br>Average profit before taxes<br>Average sales.<br>Iron Castings Society:<br>Average operating profit<br>Average sales.<br>FINSTAT:<br>Abbreviated balance sheets and income statements 1977-1980 by 4-digit SIC. | Use of median net income divided by median sales does not yield median ROS.<br>RMA data available only at level of ferrous or non-ferrous foundries.<br>Would need to use FINSTAT data to correlate ROS to predictor of failure. |

(Continued)

| | | | |
|---|---|---|---|
| Cash Flow/Total Debt | 1. Cash Flow<br>2. Total Debt<br><br>Cash flow requires net income plus depreciation. If net income to total debt is available, need either total debt plus total depreciation or depreciation to total debt.<br><br>Total debt can be derived from total assets plus debt to assets. | Dun & Bradstreet:<br><br>Median ROS<br>Median total liab. to NW (combine to return on debt)<br>Median fixed assets to net worth (combine to get fixed assets to total debt).<br><br>May infer depreciation by guessing average depreciation rate.<br><br>Robert Morris Associates:<br><br>Median sales to total assets<br>Median profit before taxes to total assets<br>Median depreciation to sales<br>Median debt to net worth.<br><br>Census (Annual Survey of Manufacturers)<br><br>Total gross depreciable assets (not depreciated)<br>Total annual depreciation (by 4-digit SIC).<br><br>Iron Castings Society:<br><br>Average capital employed<br>Average net worth (difference is average total debt)<br>Average operating profit<br>- Insufficient data. | RMA data available only at level of ferrous or non-ferrous foundries.<br><br>Census gives depreciation vs gross fixed assets; D&B provides ratios incorporating only net fixed assets. |

(Continued)

| | | | |
|---|---|---|---|
| Total Debt/Total Assets | Total Debt/Total Assets plus total debt or total assets<br><br>Total Debt/Net Worth plus total debt or net worth<br><br>Total Debt and Net Worth<br><br>Total Debt and Total Assets | Dun & Bradstreet:<br><br>Median total liab. to net worth<br>Median total assets<br>(also median total liab. and median net worth).<br><br>RMA<br><br>Median debt to net worth<br>Median total assets<br>Median net worth. | Median not consistent.<br><br>RMA data not broken down by metal type.<br><br>Projections of "typical" asset size and relation to employment unclear. |
| Interest Coverage<br>EBIT/interest payments | EBIT<br><br>Interest payments<br><br>Interest payments could be obtained from debt times interest rate. | See EBIT/Total Assets<br><br>Robert Morris Associates:<br><br>EBIT/total interest directly profit before taxes to total interest from EBIT/total interest. | Many assumptions re: interest rates, tax rates, interest bearing debt, etc.<br><br>Requires combinations of median data. |

Source: "Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Metal Molding and Casting (Foundry) Industry," U.S. Environmental Protection Agency, September 1985.

To evaluate a particular company, each of the ratios listed above should be multiplied by its co-efficient. The co-efficients were supplied by Altman in his article. The products are then summed to produce what Altman termed a "z-score". The value of this "z-score" is an indicator of the firm's financial health.

Unfortunately, as the EPA noted, the Altman function requires the ratio of the market-value of equity to the book value of debt. Since most of the firms in the foundry industry are privately held, this ratio is neither applicable nor relevant.

In reviewing the literature, the EPA found only one multivariate function (that proposed by Ohlson in 1980) whose variables could all be derived from the data at hand. Two of Ohlson's variables, unfortunately, require year-to-year changes in the ratios, which posed a problem for the foundry study, since industry aggregate data was being used.

On difficulty with the multivariate approach is that functions estimated using data from one time period may have limited applicability in later periods. Researchers testing equations developed in earlier studies have found, in some cases, much lower levels of predictive accuracy than those reported by the original authors.

Multivariate functions may also only be applicable to groups of companies that are similar to the original data sample. Many studies, for example, have focused on either large or small companies, or companies in a particular industry.

Since data limitations prevented the use of multivariate equations, the EPA decided to use single financial ratios as predictors of bankruptcy. The findings of Beaver's study, published in 1966, formed the basis of this approach.

Beaver regarded his study as a first step in the empirical verification of the efficacy of financial ratios as predictors of credit-worthiness. He noted that such verification was lacking, even though ratio analysis had been in use since the turn of the century. Beaver hoped that his study would be a "benchmark" for future investigations.

Beaver's study used data from the period 1954-1964. The EPA noted that many changes in financial and economic conditions had occurred since then: notably, inflation, corporate debt levels, and interest rates had all risen. These changes could effect the point at which financial ratios would indicate probable bankruptcy. The threshold values that Beaver reported were therefore compared to the actual values of three foundry firms that filed for bankruptcy in the three years prior to 1985 (the date of the study). The EPA also looked at trends in the median and lower quartile financial ratios of the foundry industry. Following this review, the EPA made some adjustments to Beaver's values.

Beaver developed different thresholds for predicting bankruptcy at various periods prior to a firm's failure. As would be expected, the performance, or predictive accuracy, of these thresholds decreased with increasing time to failure. In Beaver's study, short-term was considered to be within one year; medium term, from two to three years; and long term, from four to five years.

The EPA based its thresholds on Beaver's short-term values. Two reasons were sited: one, the declining performance of the longer-term indicators, and two, the EPA's use of financial statements based on quartile data.

In his article, Beaver did not indicate how the readings provided by individual ratios could be combined. The EPA decided that a firm would have to fall below the threshold of two out of the three ratios for it to be classified as "bankrupt". The justification for this was empirical: each of the three bankrupt firms that they studied in the foundry industry failed at least two of the tests. Furthermore, it seemed plausible that a firm failing just one of the tests could survive.

Although the EPA choose Return On Assets as an indicator, the Foundry study noted its theoretical disadvantage: if the "return" measured is after-tax, a more highly leveraged firm will show a lower ROA than a company with identical assets, sales and costs, but with a higher proportion of equity.

The ratio of earnings before interest and taxes (EBIT) to total assets is not influenced by the financing of the firm, and is therefore theoretically a more sound measure of underlying profitability. The EPA rejected the use of this ratio because it is not directly available from Dunn & Bradstreet, and estimating its value would entail a large number of assumptions.

## *Applicability Of The Ratio Approach To Canada*

Several researchers have applied the technique of MDA to samples of Canadian firms, in an effort to develop a Canadian business failure prediction model. In a 1983 article, Gordon Springate pointed out that one of the ratios used by Altman (Market Value of Equity/Book Value of Debt) is only available for publicly-traded corporations, and therefore would not be available for many Canadian companies, since many are either privately held or are wholly-owned subsidiaries of foreign corporations.

Springate developed his own model by analyzing the financial ratios of 20 matched pairs of failed and non-failed Canadian firms. Nineteen ratios were examined, but only four were retained in the final model, which was developed using a step-wise method of Multiple Discriminant Analysis.

The four ratios are:

1. Working capital/total assets;

2. Net profit before interest and taxes/total assets;

3. Net Profit before taxes/current liabilities;

4. Sales/total assets.

Working capital/total assets is directly available from the CCH Financial Survey, while the remaining three ratios can be readily calculated from the representative financial statements presented.

Altman himself, in conjunction with Mario Lavallee, applied the MDA technique to a sample of 42 Canadian firms, 21 of which had gone bankrupt between 1970 and 1979. Their Canadian equation included the following ratios:

1. Sales/total assets;

2. Net profit/total assets;

3. Current ratio;

4. Net profit/total debt;

5. Growth rate of equity less growth rate of total assets.

The fifth ratio (growth rate of equity less growth rate of total assets) would not be available from the CCH Financial Survey, although all of the other ratios would be.

# Appendix C

# Appendix C

## CONSERVATION AND PROTECTION REGULATORY INITIATIVES (CANADA)

| Item | Initiative | Tentative Dates Canada Gazette Part I | Part II |
|---|---|---|---|
| 1. | PCB Destruction Regulations | Completed | Jan. 90 |
| 2. | Gasoline Regulations | Completed | Feb.90 |
| 3. | Ozone-depleting Substances - Regulations No. 2 | Completed | Feb. 90 |
| 4. | Ozone-depleting Substances - Regulations No. 3 | Completed | Feb. 90 |
| 5. | Ozone-depleting Substances - Regulations No. 1 - Amendment | Oct. 90 | Dec. 90 |
| 6. | Ozone-depleting Substances - Regulations No. 2 - Amendments | Oct. 90 | Dec. 90 |
| 7. | Export of PCB Waste | Jan. 90 | Mar. 90 |
| 8. | Pulp and Paper Effluent Regulations - Amendment | May 90 | July 90 |
| 9. | Pulp and Paper Effluent Authorization Regulations | May 90 | July 90 |
| 10. | Chlorinated Dioxins and Furans Release in Pulp & Paper Mills' Effluents | May 90 | July 90 |
| 11. | Chlorinated Organic Substances | May 90 | July 90 |
| 12. | Site-specific Pulp & Paper Effluent Authorization Regulations | Apr. 90 | July 90 |
| 13. | PCB Wast Storage Regulations | April 90 | Sept. 90 |
| 14. | New Substances Notification - Polymers | Feb. 90 | May 90 |
| 15. | New Substances Notification - Biotechnology Products | June 90 | Sept. 90 |
| 16. | Export and Import of Hazardous Wastes | Sept. 90 | Nov. 90 |
| 17. | Export of Toxic Substances | Feb. 90 | June 90 |
| 18. | Confidential Information Disclosure Regulations | Mar. 90 | July 90 |
| 19. | Contaminated Fuel | June 90 | Sept. 90 |
| 20. | Chlorobiphenyl (PCB) | June 90 | Sept. 90 |
| 21. | Spill Reporting | June 90 | Sept. 90 |
| 22. | Ocean Dumping Amendments - Phase I | Sept. 90 | Dec. 90 |
| 23. | Ocean Dumping Amendments - Phase II | Sept. 90 | Dec. 90 |
| 24. | Fines and Execution of Orders Proceeds | Oct. 90 | Dec. 90 |
| 25. | Environmental Protection Boards of Review | May 90 | Aug. 90 |
| 26. | Non-hazardous Solid Waste Incinerators at Federal Facilities | June 90 | Sept. 90 |
| 27. | Vinyl Chloride Regulations - Amendments | Apr. 90 | June 90 |
| 28. | Release of Lead from Secondary Lead Smelters - Amendments | May 90 | Dec. 90 |
| 29. | Air Emissions Regulations for Boilers at Federal Facilities | June 90 | Dec. 90 |
| 30. | Hazardous Waste Management for Federal Facilities | Mar. 90 | June 90 |
| 31. | Migratory Birds - Amendment I | | Sept. 90 |

| Item | Initiative | Tentative Dates Canada Gazette Part I | Part II |
|---|---|---|---|
| 32. | Migratory Birds - Amendments II | June 90 | Sept. 90 |
| 33. | Migratory Birds - Amendments III | June 90 | Sept. 90 |
| 34. | Migratory Birds - Amendments IV | June 90 | Sept. 90 |
| 35. | Migratory Bird Sanctuary - Amendment I | Mar. 90 | June 90 |
| 36. | Migratory Bird Sanctuary - Amendment II | Mar. 90 | June 90 |
| 37. | Migratory Bird Sanctuary - Amendment III | Mar. 90 | June 90 |
| 38. | Migratory Bird Sanctuary - Amendment IV | Mar. 90 | June 90 |
| 39. | Migratory Bird Sanctuary - Amendment V | Mar. 90 | June 90 |
| 40. | Wildlife Area - Amendment I | June 90 | Sept. 90 |
| 41. | Wildlife Area - Amendment II | June 90 | Sept. 90 |
| 42. | Wildlife Area - Amendment III | June 90 | Sept. 90 |
| | REGULATIONS ROLLED OVER TO CEPA | | |
| 43. | Vinyl Chloride Regulations | Oct. 89 | Feb. 90 |
| 44. | Ocean Dumping Regulations | Dec. 88 | Oct. 89 |
| 45. | Release of Lead from Secondary Lead Smelters | Jan. 90 | Mar. 90 |
| 46. | Chlor-Alkali Mercury Release Regulations | Apr. 89 | Feb. 90 |
| 47. | Asbestos Mines and Mills Release Regulations | Apr. 89 | Feb. 90 |
| 48. | Mirex Regulations | Apr. 89 | Feb. 90 |
| 49. | Polychlorinated Terphenyl Regulations | Apr. 89 | Feb. 90 |
| 50. | Chlorofluorocarbon Regulations | Apr. 89 | Feb. 90 |
| 51. | Polybrominated Biphenyl Regulations | Apr. 89 | Feb. 90 |
| 52. | Phosphorous Concentration Regulations | Dec. 88 | Oct. 89 |

Note: RIAS has been done for Ozone - Depleting Substances Regulations No. 1.

Regulatory Affairs
February 6, 1990

# Appendix D

# Bibliography


Altman, E. "A Reply," Journal of Finance, Vol. 25, No. 5, December 1970, pp. 1169-1172.

Altman, E., "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy." The Journal of Finance, September, 1968, pp. 589-609.

Altman, E.I., R.G. Haldeman, and P. Narayanan, "Zeta Analysis: A New Model to Identify Bankruptcy Risk of Corporations," Journal of Banking and Finance, Vol. 1, (June 1977), pp. 29-54.

Altman, Edward I. and Mario Lavalle. "Un modéle discriminant de prédiction des faillites au Canada," Finance, Vol. 1, part 1 (1980), p. 74-81.

Apogee Research, Inc. 1987. The Nation's Public Works: Report on Wastewater Management. National Council on Public Works Improvement, May 1987.

Beaver, W. 1966. "Financial Ratios as Predictors of Business Failure." In, Emperical Research in Accounting: Selected Studies.

Brown, G.M. and R.W. Johnson. 1985. The Effluent Charge System in the Federal Republic of Germany. U.S. Environmental Protection Agency, Report Number EPA-230-07-85-011, July 1985.

Bureau of National Affairs. International Environmental Reporter. Various Issues.

Burnett-Hall, R.H. 1989. "Environmental Regulation in the United Kingdom." International Environmental Reporter, September 1989, p 461-470.

CCH Canadian Ltd., "Financial Survey of Canadian Business Performance, 1989 Edition." November, 1989.

Chemical Manufacturers Association and Synthetic Organic Chemical Manufacturers Association. 1985. "Comments on EPA's Revised Economic Impact Analysis in support of Effluent Limitations Guidelines and Standards for the Organic Chemicals, Plastics and Synthetic Fibers Industry." December 1985.

Cogesult Inc. 1989. "Developpment et Application d'une Methodologie d'evaluation Economique des Reglementations Environnementales au Quebec."

Collins, Robert A. "An Empirical Comparison of Bankruptcy Prediction Models." Financial Management, Summer 1980, pp. 52-57.

Commission of the European Communities. 1987. The State of the Environment in the European Community 1986. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities. 1988. European Community Environmental Legislation 1967-1987 (several volumes) Brussels: Commission of the European Communities.

Council of the European Communities. 1988. Council Directive 88/609 on the limitation of emissions of certain pollutants into the air from large combustion plants. Official Journal of the European Communities, December 7, 1988.

Davis, C.S. 1987. "European Year of Environment Emphasizes Need for E.C. Policies." Europe. May 1987, pp 30, 31.

Deakin, E.B. "A Discriminant Analysis of Predictors of Business Failure." Journal of Accounting Research, Spring 1972, pp. 167-179.

Docter Institute for Environmental Studies/Milan, ed. 1987. European Environmental Yearbook 1987. London: DocTer International U.K.

Economic and Social Consultative Assembly. 1987. European Environment Policy. Brussels: European Communities.

Edmister, R.O. "An Empirical Test of Financial Ratio Analysis for Small Business Failure Prediction." Journal of Financial and Quantitative Analysis, March 1972, pp. 1477-1493.

Eisenbeis, Robert A., "Pitfalls in the Application of Discriminant Analysis in business, Finance, and Economics." Journal of Finance, Vol. 32, No. 3, June 1977, pp. 875-911.

Environment Agency Government of Japan. 1985. Quality of the Environment in Japan 1984.

Federal Register. Vol, 47, No. 223, November 18, 1982. p. 52006-52064.

Federal Register. Vol. 47, No. 103, May 27, 1982. p. 23258-23284.

Federal Register. Vol. 47, No. 114, June 14, 1982. p. 25682-25718.

Federal Register. Vol. 47, No. 125, June 29, 1982. p. 28260-28278.

Federal Register. Vol. 47, No. 224, November 19, 1982. p. 52290-52304.

Federal Register. Vol. 47, No. 233, December 3, 1982. p. 54598-54609.

Federal Register. Vol. 49, No. 164, August 22, 1984. p. 33402-33420.

Federal Register. Vol. 50, No. 210, October 30, 1985. p. 45212-45247.

Federal Register. Vol. 50, No. 224, November 20, 1985. p. 47982-48000.

Federal Register. Vol. 52, No. 214, November 5, 1987. p. 42522-42584.

Forster, B.A. 1988. "Spatial Economic Theory of Pollution Control: Reflections on a Paradox." In, Journal of Environmental Economics and Management, December 1988, p. 470-474.

Fraas, A. and V.G. Munley. 1989. "Economic Objectives within a Bureaucratic Decision Process: Setting Pollution Control Requirements under the Clean Water Act." In, Journal of Environmental Economics and Management, July 1989, p. 35-53.

Government of Canada, Regulatory Affairs Branch, Office of Privatization and Regulatory Affairs. 1988. The Federal Regulatory Process -- A Guide for Departments and Agencies.

Government of Canada, Regulatory Affairs Branch, Office of Privatization and Regulatory Affairs. 1989. Guide for Regulatory Impact Analysis.

Johnson, C.G., "Ratio Analysis and the Prediction of Firm Failure." Journal of Finance, Dec. 1970, pp. 116-1168.

Joy, O.M. and J.O. Tollefson, "On the Financial Applications of Discriminant Analysis." Journal of Financial and Quantitative Analysis, Dec. 1975, pp. 723-738.

Kuhling, W. 1987. "Pollution: Air: Germany, F.R." In, Docter Institute for Environmental Studies/Milan, ed. European Environmental Yearbook 1987. London: DocTer International U.K.

Linnerooth, J. and A.V. Kneese. 1989. "Hazardous Waste Management: a West German Approach." Resources (Resources for the Future), Summer 1989, p. 7-10.

Moyer, C., "Forecasting Financial Failure: A Re-Examination." Financial Management, Spring 1977, pp. 11-17.

Ohlson, J.A., "Financial Ratios and the Probabilistic Prediction of Bankruptcy." Journal of Accounting Research," Vol. 18, No. 1, Spring 1980.

Ontario Ministry of the Environment, Policy and Planning Branch. 1987. Economic Information Needs and Assessments for Developing MISA Monitoring and Abatement Requirements. Queen's Printer for Ontario.

Ontario Ministry of the Environment, Policy and Planning Branch. 1988. "Economic Assessments of MISA Regulations for Direct Industrial Dischargers in Ontario." Paper present at the Technology Transfer Conference, Toronto, Ontario, November 28, 1988.

Ontario Ministry of the Environment, Policy and Planning Branch. 1989a. Monitoring Cost Estimates and Their Implications for Direct Dischargers in the Electric Generation Sector: Draft. Queen's Printer for Ontario.

Ontario Ministry of the Environment, Policy and Planning Branch. 1989b. Monitoring Cost Estimates and Their Implications for Direct Dischargers in the Ontario Inorganic Chemical Industry: Final Report. Queen's Printer for Ontario.

Ontario Ministry of the Environment. "Guidelines for an Economic Analysis of Private Sector Pollution Abatement and Environmental Protection Measures." Policy 02-01.

Ontario Ministry of the Environment. "Ministry of the Environment Policy Manual, Policy 16-03- 01, 16-02-01, and 16-04-01."

Organization for Economic Cooperation and Development. 1989a. Economic Instruments for Environmental Protection. Paris: OECD.

Organization for Economic Cooperation and Development. 1989b. Water Resource Management Integrated Policies. Paris: OECD.

Pedersen, W.F., 1985. "Ecological Paralysis: Why Europe Can't Clean Itself Up." The Washington Post, June 16, 1985, p. C1, C2.

Plourde, C. and D. Yeung. 1989. "A Model of Industrial Pollution in a Stochastic Environment" In, Journal of Environment Economics and Management. March 1989, p97-105.

Prabhu, M.A. 1988. "Toxic Chemicals and Hazardous Wastes: An Overview of National and International Regulatory Programs." International Environmental Reporter, December 1988, p.687-693.

Rose, P.S. et al. "Predicting Business Failure: A Macroeconomic Perspective." Journal of Accounting Auditing and Finance, Vol. 6, No. 1, Fall 1982, pp. 20-31.

Sands, E., G. Springate and T. Var, "Predicting Business Failures." CGA Magazine, May, 1983, pp. 24-27.

Simonis, U. 1987. "A Short History of Environmental Policy in West Germany." In, Doctor Institute for Environmental Studies/Milan, ed. European Environmental Yearbook 1987. London: DocTer International U.K.

Singer, Grace L. 1982. The European Experience: Issues in Water Quality and Drinking Water Treatment. Report to the German Marshall Fund, Washington, D.C.

The Economist. "Green, greener, greenest?" May 6, 1989, p. 67.

The Economist. "The freedom to be cleaner than the rest." October 14, 1989, p. 21-23.

United States Congress, Congressional Budget Office. 1985. Environmental Regulation and Economic Efficiency. Washington, D.C.: U.S. Government Printing Office.

United States Environment Protection Agency. 1984. Financial Capability Guidebook.

United States Environmental Protection Agency, Effluent Guidelines Division. 1979. Development Document for Existing Source Pretreatment Standards for the Electroplating Point Source Category. Washington, D.C.: U.S. Government Printing Office.

United States Environmental Protection Agency, Effluent Guidelines Division. 1983. Development Document of Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category. Washington, D.C.: U.S. Government Printing Office.

United States Environmental Protection Agency, Hazardous Waste Engineering Research Laboratory. 1985. Guidance and Feasibility Studies Under CERCLA. Washington, D.C.: U.S. Government Printing Office.

United States Environmental Protection Agency, Hazardous Waste Management Division. 1976. Assessment of Industrial Hazardous Waste Practices, Electroplating and Metal Finishing Industries Job Shops. Washington, D.C.: Government Printing Office.

United States Environmental Protection Agency, Office of Planning and Evaluation. 1989. The Municipal Sector Study -- Impacts of Environmental Regulations on Municipalities," Washington, D.C.: U.S. Government Printing Office.

United States Environmental Protection Agency, Office of Policy Planning and Evaluation. 1987. EPA's Use of Benefit-Cost Analysis: 1981-1986. Washington, D.C.: U.S. Government Printing Office.

United States Environmental Protection Agency, Office of Solid Waste. 1988. "Regulatory Impact Analysis of the Land Disposal Restrictions of First Third Wastes: Final Report." Final Report." August 1988.

United States Environmental Protection Agency, Office of the Comptroller. 1989. The Cost of Environmental Protection: EPA, the States, and Local Governments. Washington, D.C.: U.S. Government Printing Office.

United States Environmental Protection Agency, Office of Water Regulations and Standards. 1985. Economic Impact Analysis of Effluent Limitations Guidelines for the Metal Molding and Casting (Foundry) Industry. Washington, D.C.: U.S. Government Printing Office.

United States Environmental Protection Agency, Office of Water Regulations and Standards. 1987. Economic Impact Analysis of Effluent Limitations Guidelines and Standards for the Organic Chemicals, Plastics and Synthetic Fibers Industry. Washington, D.C.: U.S. Government Printing Office.

United States Environmental Protection Agency. 1989a. "Pesticide Manufacturing Facility Census for 1986: Part A. Technical Information". January 17, 1989.

United States Environmental Protection Agency. 1989b. "Pesticide Manufacturing Facility Census for 1986: Part B. Financial and Economic Information". January 17, 1989.

United States General Accounting Office. 1984. Cost-Benefit Analysis Can Be Useful In Assessing Environmental Regulations, Despite Limitations. Washington, D.C.: U.S. Government Printing Office.

United States National Science Foundation. 1983. Workshop on Effects of Environmental Regulation on Industrial Compliance Costs and Technological Innovation Held at Washington, DC on September 10-11, 1981. Washington, D.C.: U.S. Government Printing Office.

Wassersug, S.R. 1989. "The Role of Risk Assessment in Developing Environmental Policy." International Environmental Reporter, January 1989 (summary of German Marshall Fund report), p. 33-40.

Wright, P. 1989. "Europe Goes on Environment Alert." Europe, May 1989, p. 32-33.